0042491

JUL 24 1995 START 9513385.0610

Sta #4

ENGINEERING DATA TRANSMITTAL

Page 1 of 2

1. EDT № 611563

To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
TWRS Compliance Plans	Plant Systems Engineering	609538
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: C. D. Meng	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for ~~the In Situ Disposal Alternative, the Tri-Party Agreement Alternative, and the~~ Waste Retrieval and Transfer ~~Alternative.~~ EKF 7/20/95 Environmental, Safety, and QA approvals required by WHC-CM-3-5, Section 12.7 were obtained on Rev. B of this document (EDT 609538). The only significant changes in this revision, relative to Rev. B, involved changes to data tables.		9. Equip./Component No.: n/a 10. System/Bldg./Facility: n/a
11. Receiver Remarks:		12. Major Assm. Dwg. No.: n/a 13. Permit/Permit Application No.: n/a 14. Required Response Date: n/a

NOV 1995 RECEIVED EDMC

15.		DATA TRANSMITTED			(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	WHC-SD-WM-EV-099		0	No Disposal Action Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng. E. A. Fredenburg E A Fredenburg 7/20/95	Safety (approved by J. M. Garcia on EDT 609538)		
2	1	Cog. Mgr. G. L. Burford 7/20/95	Env (approved by R. H. Engelmann on EDT 609538)		
		QA (approved by J. Weber on EDT 609538)			

18.	19.	20.	21. DOE APPROVAL (if required)
S.A. Morris 7/19/95 Signature of EDT Originator Date	L. E. Borneman 7/20/95 Authorized Representative Date for Receiving Organization	G. L. Burford 7/24/95 Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments [x] not required per waiver WA-557 EKF 7/20/95

EDT-011563 Pg. 2of

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT ~~609538~~

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
TWRS Compliance Plans	TWRS Process Technology	n/a
5. Proj./Prog./Dept./Div.:	6. Cog. Engr.:	7. Purchase Order No.:
Tank Waste Remediation System	C. D. Meng	n/a

8. Originator Remarks:
This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement (EIS). Data in this document supports the no disposal action alternative for tank waste. This EDT transmits the engineering data package for the no disposal action of tank waste to TWRS Compliance Plans as Rev. A, for DOE-RL approval, per WHC-CM-3-5, Section. 12.7.

11. Receiver Remarks:

9. Equip./Component No.: n/a

10. System/Bldg./Facility: n/a

12. Major Assm. Dwg. No.: n/a

13. Permit/Permit Application No.: n/a

14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-099		~~A~~ MD 03/14/95	No Disposal Action Engineering Data Package for the Preliminary Tank Waste Remediation System Environmental Impact Statement	E/S/Q ~~D~~ 03/14/95 MD	1/1/1 4	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng.	CDMeng	3/9/95	H5-27						
1	1	Cog. Mgr.	DJ Washenfelder	3/9/95		Disposal Programs, J.O. Honeyman	[signature]	3/14/95			
1		QA	[signature]	3/14/95		L.E. Borneman					
1	1	Safety	[signature]	3/9/95	R3-09	~~J. M. Garcia~~					
1	1	Env.	[signature]	3-15-95	H6-26						

18. CDMeng
C.D. Meng 3/9/95
Signature of EDT Originator Date

19. LE Borneman
L.E. Borneman 3/9/95
Authorized Representative Date for Receiving Organization

20. D.J. Washenfelder [signature]
Cognizant Manager Date 3/8/95

21. DOE APPROVAL (if required)
Ctrl. No.
[] Approved
[] Approved w/comments
[] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

9513385.0611

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-EV-099, REV 0
Document Title:	No Disposal Action Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement
Release Date:	7/21/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz (signature) — Kara M. Broz   7/21/95

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy. Available in paper copy. Printed in the United States of America. To obtain copies of this report, contact:

Westinghouse Hanford Company - Document Control Services
P.O. Box 1970, Mailstop H6-08, Richland, WA 99352
Telephone: (509) 372-2420; Fax: (509) 376-4989

9513385.0612

SUPPORTING DOCUMENT

1. Total Pages ~~87~~ 88 KMB 7/21/95

2. Title

No Disposal Action Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement

3. Number

WHC-SD-WM-EV-099

4. Rev No.

0

5. Key Words

no disposal, environmental impact statement, NEPA

6. Author

Name: C. D. Meng/K. L. Morris/ E. A. Fredenburg

E A Fredenburg

Signature

Organization/Charge Code 74A00/D1DDB

7. Abstract

This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for Waste Retrieval and Transfer (WHC-SD-WM-EV-097). Other Engineering Data Packages describing alternatives to be evaluated in the TWRS Environmental Impact Statement include WHC-SD-WM-EV-101 (In Situ Disposal Alternative), WHC-SD-WM-EV-103 (No Separations Alternative), WHC-SD-WM-EV-100 (Extensive Separations Alternative), and WHC-SD-WM-EV-104 (Tri-Party Agreement Alternative). The Closure Engineering Data Package (WHC-SD-WM-EV-107) provides additional information supporting each of the disposal alternatives. Data provided in this engineering data package relate to impacts from construction, operations, resource utilization, transportation, and radiation dose to workers. Unit processes addressed include tank farm operations and evaporator operations. Under the No Disposal Action Alternative, storage of existing tank wastes is continued for 100 years. Construction of new tanks, and retrieval and transfer of wastes to the new tanks, is assumed to occur twice during this 100 year period.

8. RELEASE STAMP

OFFICIAL RELEASE (58)
BY WHC
DATE JUL 24 1995
Sta #4

9513385.0613

WHC-SD-WM-EV-099 Rev 0

UC-630

No Disposal Action Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement

C. D. Meng
K. L. Morris
E. A. Fredenburg

Date Published
July 1995

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company P.O Box 1970 Richland, Washington

Management and Operations and Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

CONTENTS

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TERMS

cfm	cubic feet per minute
Cs	cesium
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EIS	environmental impact statement
EPA	Environmental Protection Agency
ETF	Effluent Treatment Facility
gal	gallon
gpm	gallons per minute
HVAC	heating, ventilation, and air-conditioning
LLW	low-level waste
m^3	cubic meter
OSHA	Occupational Safety and Health Administration
PNL	Pacific Northwest Laboratories
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
Sr	strontium
SST	single-shell tank
TAPS	Task Authorization and Planning System
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

On January 28, 1994, the U.S. Department of Energy (DOE) announced via a Notice of Intent in the Federal Register that an environmental impact statement (EIS) would be prepared for disposal of the wastes in 177 underground storage tanks and the approximately 2000 cesium (Cs) and strontium (Sr) capsules at the Hanford Site. The purpose of the EIS is to identify and evaluate the impacts of the proposed actions in the recently amended Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al., 1994).

The Westinghouse Hanford Company (WHC) Tank Waste Remediation System (TWRS) has been assigned the task of preparing this EIS. The Tank Waste Remediation System has established an outline for the EIS stating that it will encompass the following five treatment alternatives:

- Tri-Party Agreement preferred alternative
- No disposal action
- Extensive pretreatment
- No separations
- In-situ disposal.

In addition to the above alternatives, the following three other data packages will be created:

- Waste retrieval and transfer
- Tank closure
- Deposition of cesium and strontium capsules.

Engineering data will be provided to the Jacobs Engineering Company, the EIS preparer, in the form of tables and figures. The necessary data will be equivalent to the data prepared for the *Environmental Impact Statement for the Disposal of Hanford Defense High-Level Transuranic and Tank Wastes* (DOE 1987), plus any additional information the EIS preparer requests. All data will be compiled into individual data packages. The data packages will then be combined into a single document by Westinghouse Hanford Company before being transmitted to the EIS preparer.

This document is the data package for the No Disposal Action alternative.

1.1 SCOPE

The No Disposal Action alternative would continue monitoring the radioactive waste in the underground storage tanks for 100 years. At the end of that time, it is assumed that institutional control would be lost. Retrieval and closure will not be covered in this data package but in separate data packages. In addition, the disposition of the cesium and strontium capsules is not addressed.

1.2 DESCRIPTION OF HANFORD WASTES

There are 28 double-shell tanks (DSTs) and 149 single-shell tanks (SST) containing the radioactive byproducts from 50 years of spent fuel and waste processing at the Hanford Site. In order to operate these underground waste storage tanks, transfer systems are provided, which include piping, junction boxes, leak detection systems, and miscellaneous small underground tanks. A variety of processes have been used over the years, resulting in several distinct categories of waste: sludge, hard salt cake, and supernatant. Initially, sludges from the various processes were segregated. Over the years, sludges were intermixed to a large extent (uranium metal and strontium recovery); the salts and supernatants have been intermixed to an even greater extent in an effort to conserve tank space and stabilize tanks. Figure 1-1 is a cross section showing the shape, size, and important features of the SSTs and DSTs. Figure 1-2 shows the typical instrumentation configuration of SSTs. Figure 1-3 shows the typical instrumentation configuration of DSTs. Figure 1-4 shows the 200 East and 200 West tank farms and their relation to some of the waste producing facilities. The dotted line in the middle of the figure indicates the division between the 200 West and 200 East areas; physically there is a distance of five miles between the two areas. The lines between the waste producing facilities and the tank farms represent routes and not the number of pipes.

1.3 DESCRIPTION OF NO DISPOSAL ACTION ALTERNATIVE

The No Disposal Action alternative would continue the monitoring of the radioactive waste projected to be in the underground storage tanks for the next 100 years. At the end of the 100 years, it would be assumed that institutional control is lost. Because of the differences in physical condition, the SSTs and DSTs would be handled differently as shown below.

1.3.1 Single-Shell Tank Waste

Under the no disposal alternative, existing SST waste would continue to be stored in tanks. These tanks contain ^{90}Sr and ^{137}Cs, other fission products, and transuranic elements. Improvements to enhance confinement would consist of practices now underway: production of concentrated DST solution from SST interstitial liquid, stabilization of salt cake and sludges, and isolation of the SSTs. To the extent reasonable, liquid would be removed from salt cake now stored in SSTs (to no more than 190 cubic meters [m^3] residual per tank). The tanks and contaminated soil would be monitored. Soil contaminated from tank leaks and spills would be left in place.

9513385.0010

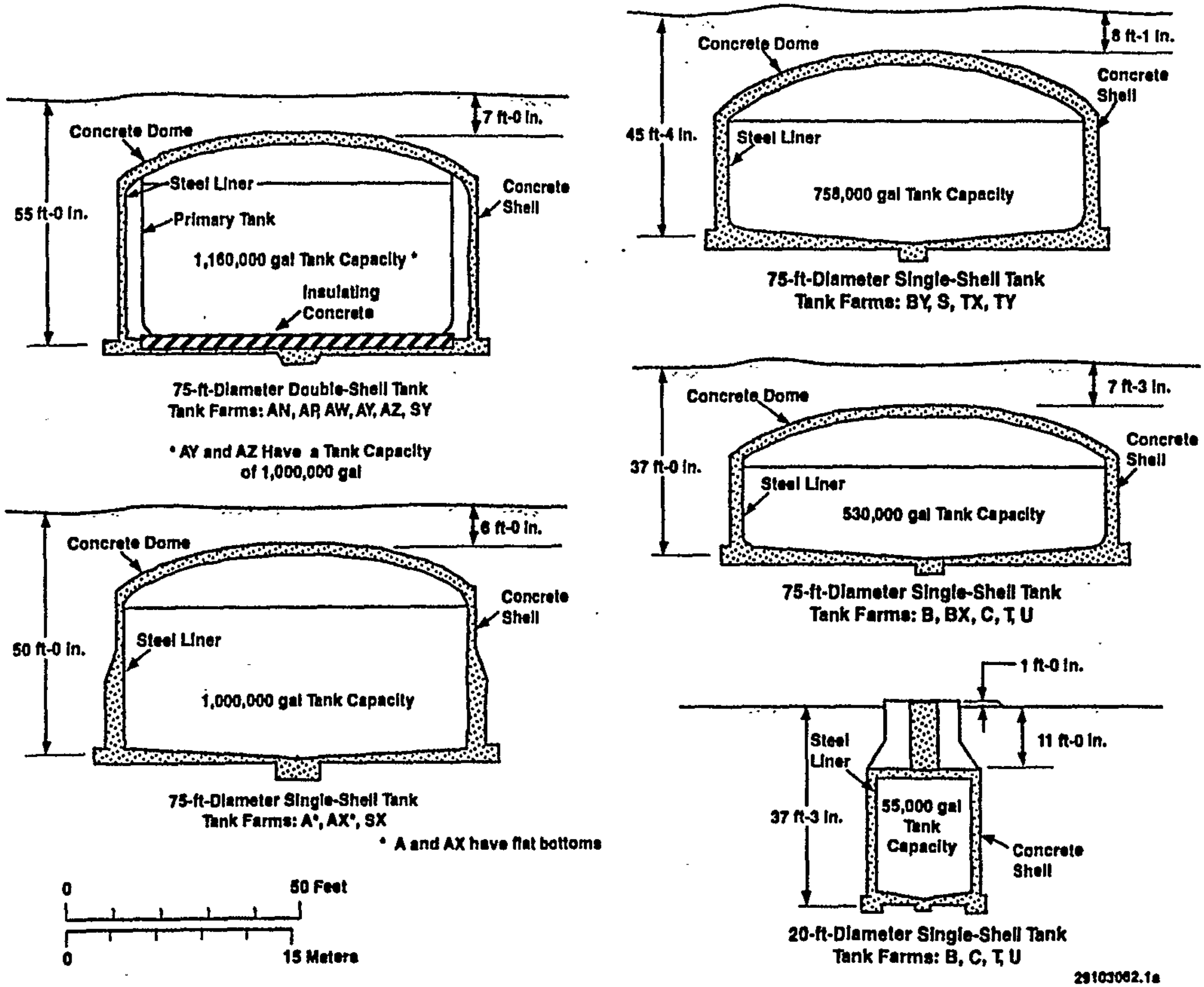


Figure 1-1. High-Level Waste Tank Configuration.

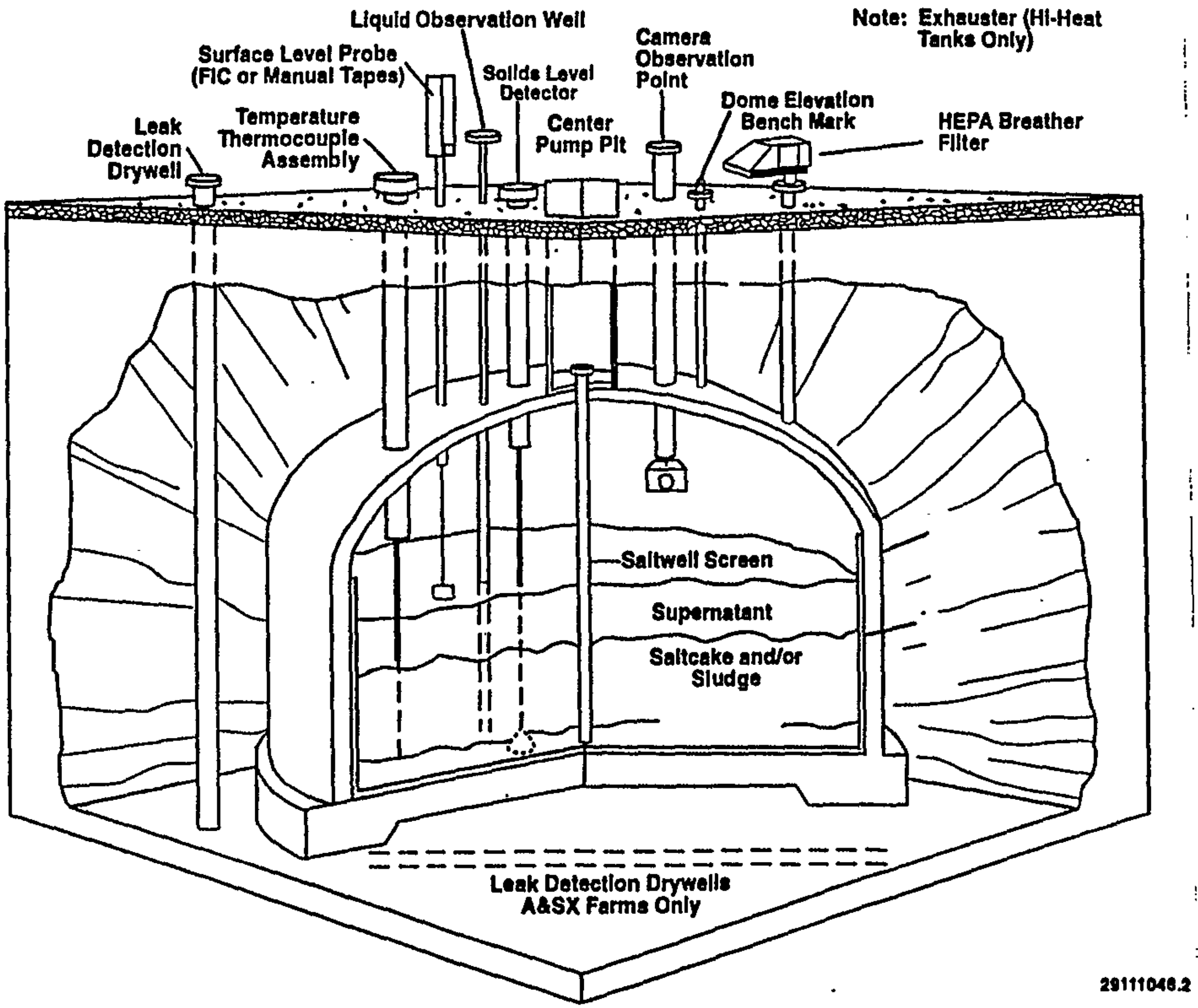


Figure 1-2. Generalized Single-Shell Tank Instrumentation Configuration.

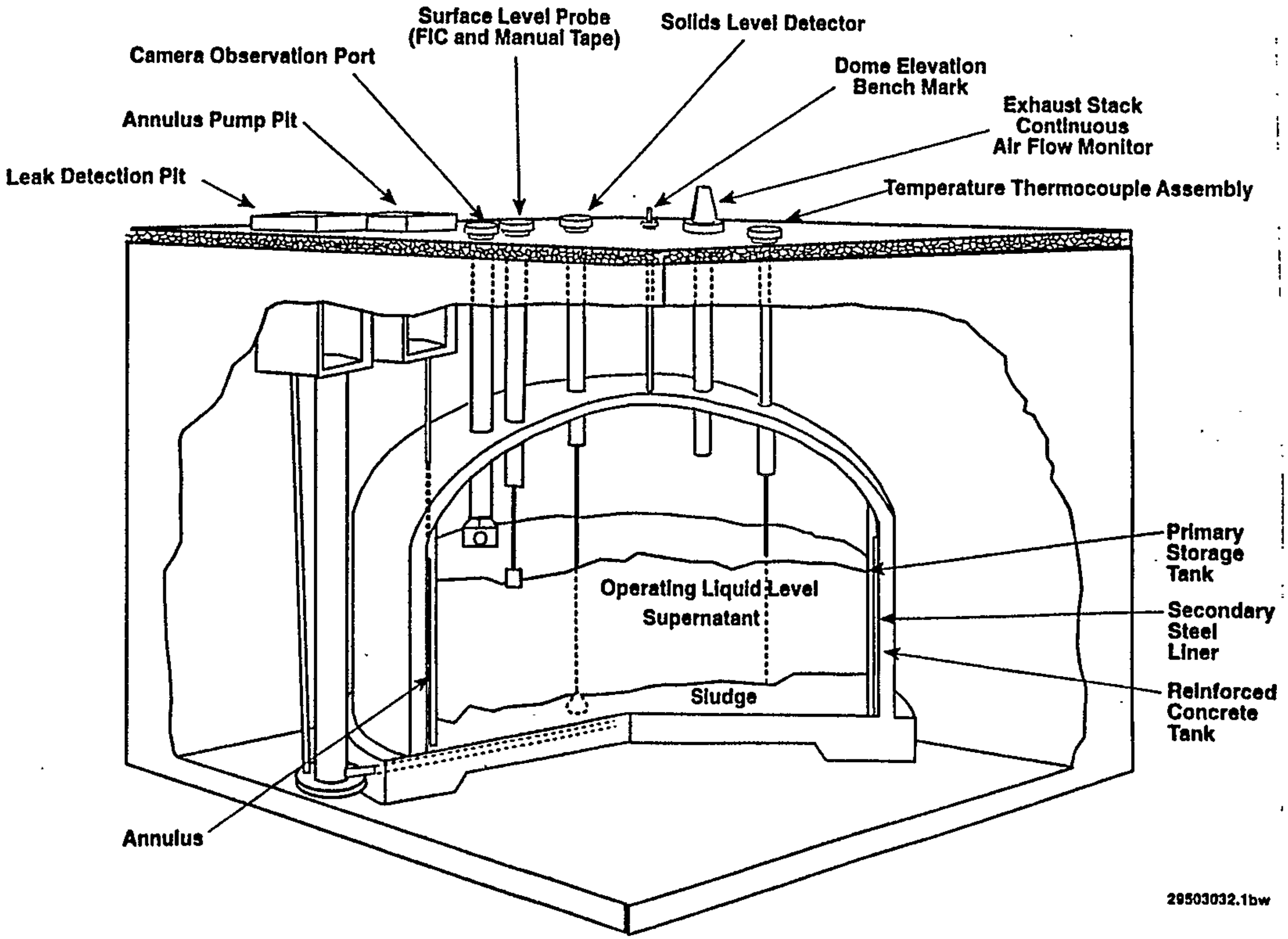
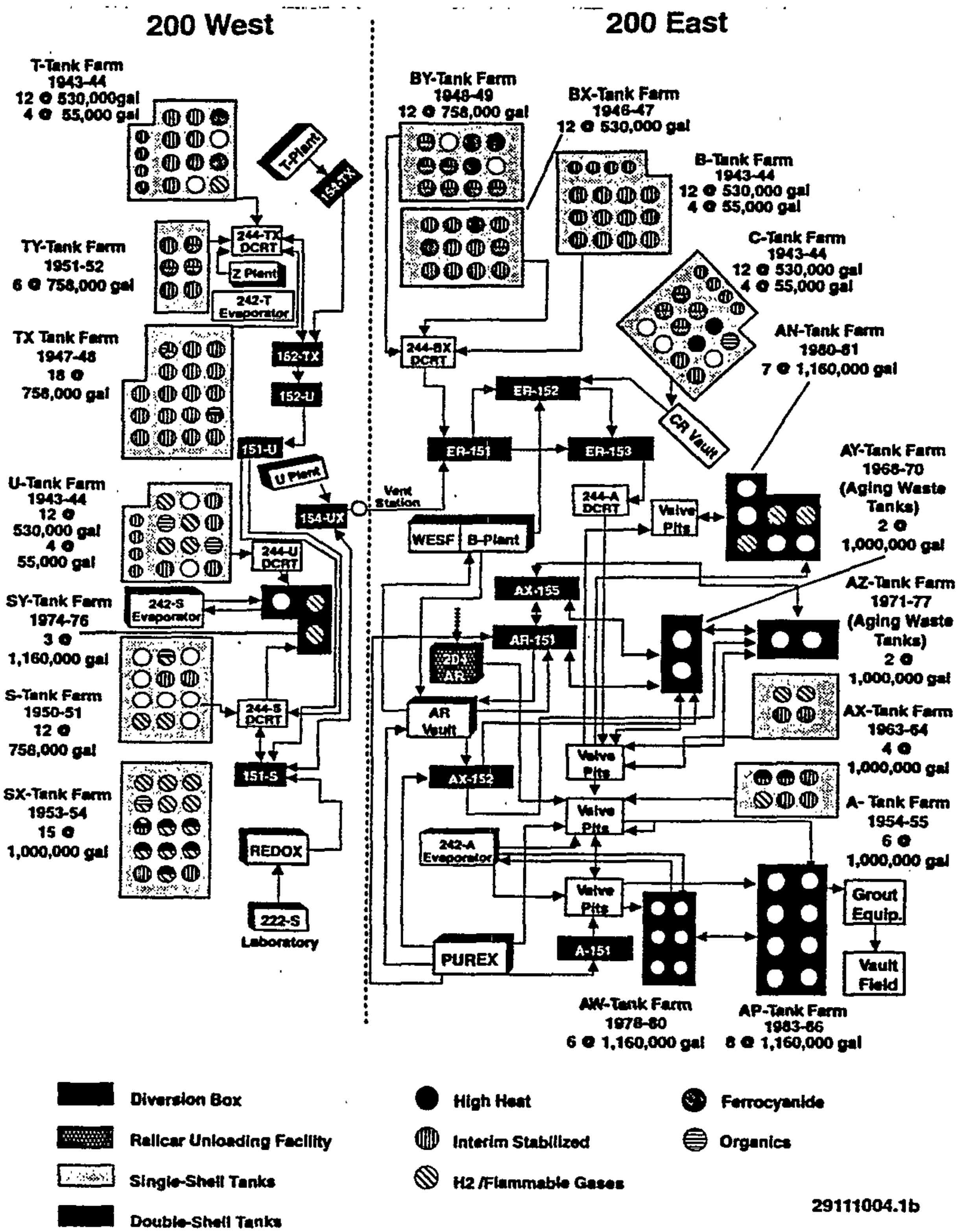


Figure 1-3. Double-Shell Tank Instrumentation Configuration.

Figure 1-4. Hanford Site Tank System Schematic Diagram.



Of the 149 SSTs, currently 106 have been interim stabilized, 98 have intrusion prevention completed, 67 are assumed leakers, 48 are on the Watch List, and 119 have less than 190 m^3 of drainable interstitial liquid (Hanlon 1994). A Watch List Tank is an underground storage tank containing waste that requires special safety precautions because it may have a serious potential for release of high-level radioactive waste because of uncontrolled increases in temperature or pressure. Of the 48 SSTs on the Watch List, 18 have been interim stabilized and 27 have intrusion prevention completed.

Structural analysis of tank design and laboratory testing of concrete samples from SSTs show the probability of tank dome failure before loss of institutional control from deterioration or earthquake-induced forces to be slight (RHO 1985). Nevertheless, dome elevations would continue to be monitored under the No Disposal Action alternative. Maintenance on the tanks and support structures would continue, and risers and other opening into the tanks would continue to be capped in an effort to isolate the tanks (i.e., prevent liquids from entering or leaving the tank). Drywell monitoring would continue and upgrades to the drywells would be made as necessary. In case of any evidence of dome deterioration or damage, empty tank space would be filled with grout or gravel to minimize the potential for subsidence of the dome and overlying soil. For a description of filling the tanks with grout or gravel, refer to the *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Kline et al.). This preventive measure is important as sudden collapse of the dome and overburden could release radioactivity or hazardous waste as particulate matter from the waste in the tank.

Surveillance under the No Disposal Action alternative would be provided appropriate to the degree of isolation of the tanks. Thus, surveillance would be continued at the current level until the adequacy of isolation procedures could be confirmed. Site services (security, fire protection, environmental monitoring, and utilities) would be maintained at current levels.

1.3.2 Double-Shell Tank Waste

The neutralized waste from the Plutonium-Uranium Extraction plant (PUREX) and other smaller process contributors is stored in DSTs. These tanks contain ^{90}Sr and ^{137}Cs, other fission products, and transuranic elements. Of the 28 DSTs, none have leaked; six are on the Watch List.

Under the No Disposal Action alternative, liquid waste and slurries now stored in DSTs would continue to be monitored and kept under surveillance. Spare DST space would continue to be maintained in condition to receive this waste in case of tank failure. Because the design life of DSTs is 50 years, all DST waste is assumed to be transferred to new tanks at that frequency. The liquids would be reconcentrated during transfer by evaporation of any water added for retrieval. The periodic waste transfer process would end after the second retanking. Surveillance and monitoring of the stored waste in the DSTs would continue. Site services (security, fire protection, environmental monitoring, and utilities) would be maintained at current levels.

The flowsheet for the No Disposal Action alternative is shown in Figure 1-5. The No Disposal Action alternative would continue to stabilize the SSTs by pumping the supernate and interstitial liquid from the SSTs to the DSTs. Following stabilization, the SSTs would be isolated to prevent intrusion. During the stabilization and intrusion prevention processes and until institutional control is lost, the SSTs and DSTs would be monitored and maintained. At the end of the design life of the DSTs, new DSTs and an evaporator would be built to replace the old DSTs. After the new DST construction is complete, the waste in the old DSTs would be retrieved. The supernate would be transferred directly to the new tanks. The slurry (sludge) would be retrieved using dilution water (3-to-1 dilution) with mixer pumps and transfer pumps. The retrieved slurry would be concentrated in an evaporator and the waste would go to the new DSTs while the evaporator condensate would mostly be used to retrieve tank waste or as dilution water. At the end of the retrieval period, the evaporator condensate would be treated and released. The waste would be transferred to a second set of new DSTs at the end of the DST design life (50 years).

1.4 NO DISPOSAL ACTION ALTERNATIVE ASSUMPTIONS

Under the No Disposal Action alternative, the following assumptions were made:

1. The current Hanford waste management practices would be continued for a total of 100 years from the dates that the original DSTs were filled.

2. The SSTs would have been (a) jet pumped at the minimal flow rate practical to remove free liquids, and (b) then isolated with at least one barrier to minimize liquid intrusion.

3. New evaporators would be required for the projected two new retanking episodes.

4. The old DSTs would be deactivated and isolated. Potential collapse of a tank roof would be dealt with by filling in the empty tank space with grout or gravel.

5. Approximately 1 percent of the original waste would remain in the original DSTs.

6. The isolated tanks would receive a degree of surveillance through approximately 2030, by which time the adequacy of the initial isolation procedures would have been confirmed.

7. After 2041, two of the DSTs would continue to require forced ventilation for heat removal. Radioactive surveillance subsequently would be continued at a reduced level.

8. Active site controls would be maintained during the balance of the 100-year period.

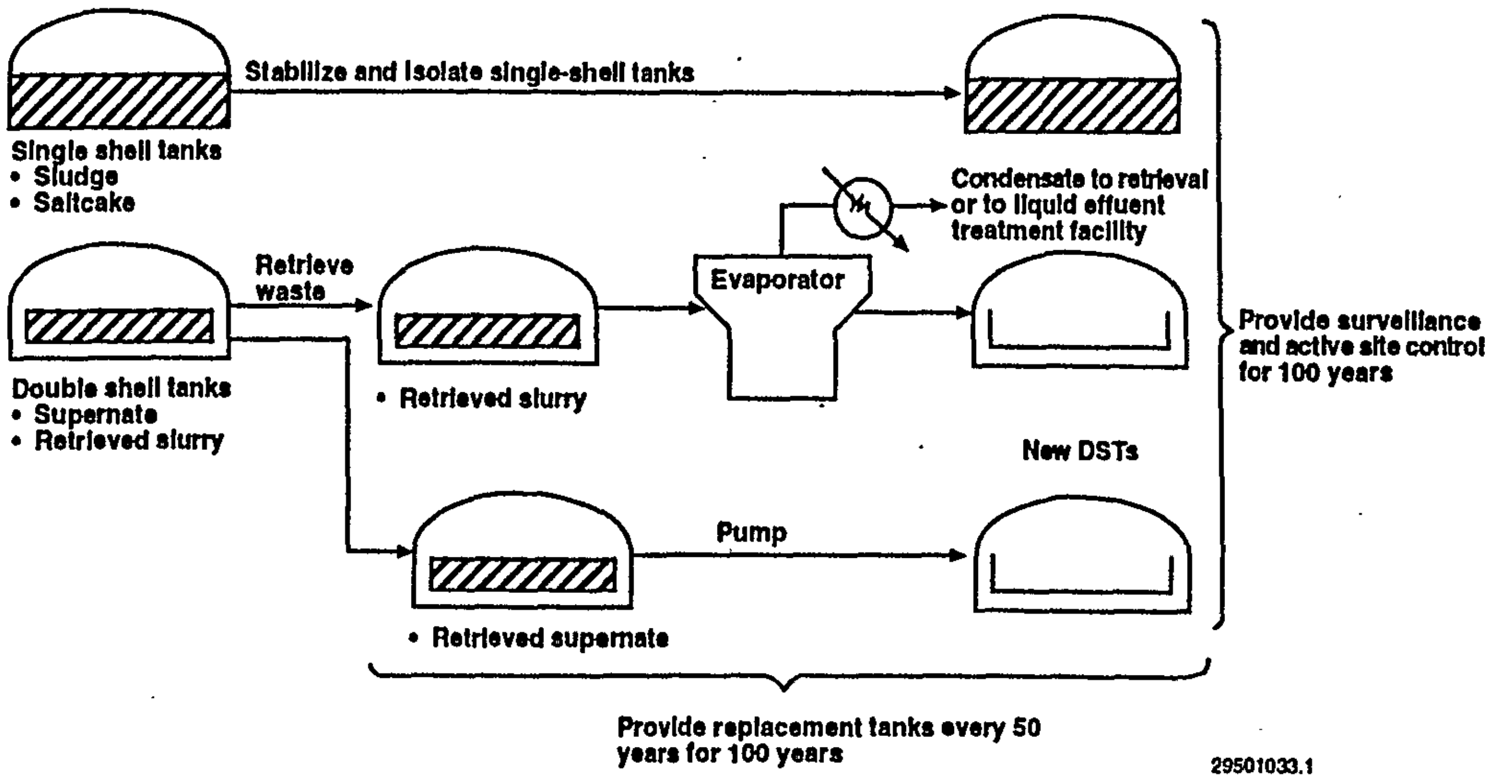


Figure 1-5. No Disposal Action Alternative Flowsheet.

The projected volume of waste in the DSTs and the number of replacement DSTs assumes the following:

1. The terminal clean out of all facilities would be completed as scheduled in 2005. The volume of waste in the tanks would remain nearly constant between 2005 and 2037 as an effluent treatment facility would be available to handle evaporator condensate, leachate from sanitary waste drain trenches, contaminated water from rain or snowmelt, etc. Following the design life (30 years) of the effluent treatment facility, the only major source of liquid waste to be treated would be condensate from the new evaporators. Each new evaporator would include the necessary condensate polishing to meet release requirements. Laboratory waste liquids would be a small enough volume to fit in the existing tanks. The first retanking would begin in 2037 and require a minimum of five years to accomplish because of waste retrieval and evaporator operations.

2. The 242-A evaporator would be available up to 2005 to concentrate the terminal clean out wastes.

3. The existing tank waste would be combined in the new tanks in such a way as to fill the new tanks to their operating limit. Operating limit on DSTs constructed after 1974 would be 4320 m^3 (1,140,000 gallons [gal]) per tank as reported in the *Tank Farm Surveillance and Waste Status Summary Report* (Hanlon 1994).

4. One tank would remain empty as a contingency for a leaking DST (DOE 5820.2A). Aging waste would not be a factor in 2037 during the retanking as another half-life of ^{137}Cs and ^{90}Sr (30 years) would have passed, which would reduce the heat load of the waste. Therefore, there would be no aging waste and segregation of the waste into aging waste tanks would not be required. Thus, a separate contingency tank would not be required for aging waste.

5. An evaporator would be provided to concentrate waste after retrieval and before transfer to the new tanks so that the same volume would exist in the new tanks.

2.0 PROCESS DESCRIPTION

The No Disposal Action alternative would continue the monitoring of the radioactive waste projected to be in the underground storage tanks for 100 years. The processes used to accomplish this objective are divided into separate SST and DST sections below.

2.1 SINGLE-SHELL TANK PROCESSES

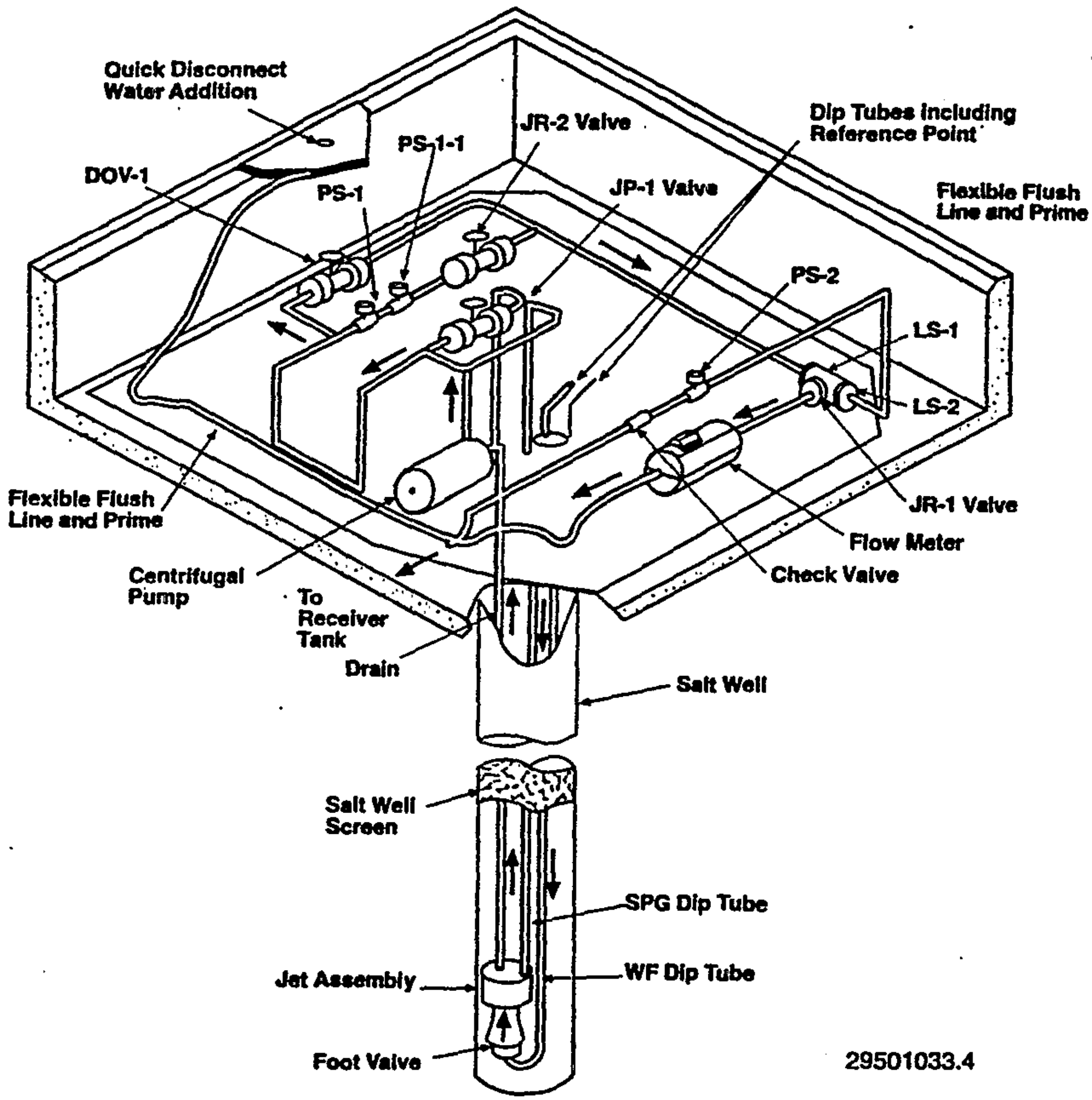
Over the years of operation, 67 of the SSTs have had measurable, unexplained liquid losses. They are assumed to have lost integrity and established a pathway for the contents of the tank to migrate to the surrounding environment. The first step to prevent transfer of liquid radioactive waste from these tanks to the environment is interim stabilization of all the SSTs. Interim stabilization is intended to reduce the liquid content of wastes to the greatest extent technically and economically feasible to minimize the risk associated with loss of tank integrity and exposure of the contents of the tank to the general environment. The next step to prevent transfer of liquid radioactive waste is intrusion prevention of the tanks and associated facilities.

2.1.1 Interim Stabilization

The objective of interim stabilization is to reduce the volume of radioactive liquid in the SSTs so it will not flow through holes in the tank to the environment (leaving behind the less mobile radioactive solids). A tank that contains less than 190 m^3 (50,000 gal) of drainable interstitial liquid and less than 19 m^3 (5,000 gal) of supernatant liquid is considered interim stabilized. If the tank was jet pumped to achieve interim stabilization, then the jet pump flow rate must also have been at or below 3.2×10^{-6} m^3/s (0.05 gallons per minute [gpm]) before interim stabilization criteria is met.

The jet pump system (see Figure 2-1) includes (1) a jet assembly with foot valve mounted to the base of two pipes that extend from the top of the well to near the bottom of the well casing inside the saltwell screen, (2) a centrifugal pump to supply power fluid to the downhole jet assembly, (3) flexible or rigid transfer jumpers, (4) a flush line, and (5) a flowmeter. The jumpers contain piping, valves, and pressure and limit switches. The saltwell screen is a section of 10-inch pipe with small openings 0.127 centimeter (0.05 inches) in it that extends to near the bottom of the waste tank. During jet pump operation, interstitial liduid is removed through the saltwell into the pump pit (nominal 12.3 m [40 foot] rise). Pumping rates vary from 3.2×10^{-6} m^3 per second (0.05 gpm) to about 2.56×10^{-4} m^3 per second (4 gpm). The liquid is sent to a DST or the high-level waste evaporator.

Figure 2-1. Typical Salt Well Jet Pump Assembly.



2.1.2 Intrusion Prevention

The purpose of intrusion prevention is to prevent liquid from entering a stabilized (less than 190 m^3 pumpable liquid) SST and mobilizing the existing radioactive waste into flowing through the holes in the tank into the environment. Intrusion prevention is implemented by the placement of at least one physical barrier to the transport of radionuclides from an inactive radiologically contaminated facility to the general environment. Examples of places where physical barriers (does not include valves) are used to prevent intrusion are: (1) above-grade risers, (2) pipelines at high hydraulic end, (3) pits, and (4) encasements. The equipment is sealed against the intrusion of liquid by a closure that seals against a minimum pressure of 12-inches w.g. Some seals on facilities (for example, pits, diversion boxes, vaults, etc.) must also prevent loss of confinement of airborne radionuclides. (See *Criteria for Interim Isolation of Radioactively Contaminated Tank Farm Facilities at Hanford*, (Alstad 1990) for more details on the criteria for intrusion prevention.)

Under no circumstances are electrical or instrumentation devices disconnected or disabled during the intrusion prevention process (with the exception of the electrical pump).

2.2 DOUBLE-SHELL TANK PROCESSES

The design life of the DSTs is 50 years and thus far no DST has lost integrity. Therefore, monitoring the DSTs will continue until replacement at the end of their design life. The following sections discuss the number of replacement tanks needed to retank the waste and the details of those replacement tanks.

2.2.1 Number and Size of Replacement Double-Shell Tanks

The existing DSTs were introduced gradually during the 1970's. The No Disposal Action alternative includes plans to replace the existing tanks twice at 50-year intervals to eliminate potential problems associated with their developing serious leaks through both shells. By the time 50 years have passed after the second retanking (5 half lives), radioactivity levels from the ^{137}Cs and ^{90}Sr will have dropped by a factor of 97 percent (3 percent remaining). The first planned retanking construction would start about the year 2033. The last retanking construction is planned to start in the year 2083 (see Figure 2-2 for construction schedule which is an updated version of Figure 3-22 in the *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS* [RHO 1985]).

The replacement tanks would have a diameter of approximately 23 m (75 ft), be capable of storing approximately 3800 m^3 (1 million gal) of waste, and contain mixer pumps and a transfer pump. The number of new tanks needed to hold the projected DST waste was determined to be 26 (see Appendix A for calculation), which includes a spare tank for contingency (leaking DST).

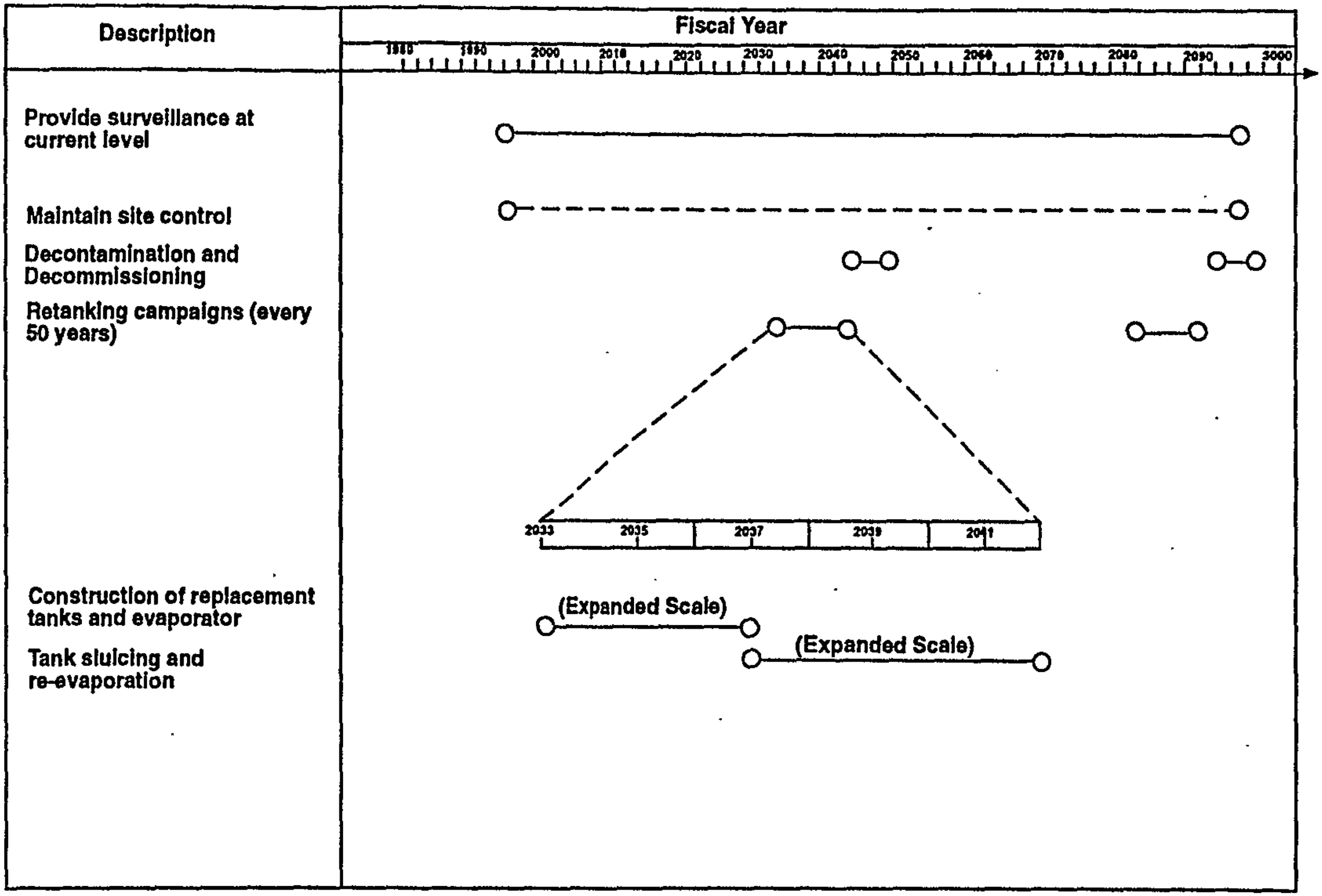


Figure 2-2. Retanking Construction and Evaporation Schedule.

2.2.2 Replacement Double-Shell Tanks

The new DSTs would have support facilities as shown in Figure 2-3. Miscellaneous support structures would be provided including a diesel generator building, gas sample buildings, and stack monitoring facility. The diesel generator would provide backup power, and the diesel fuel tank would be double-contained and regulatory-compliant. The design would include an administration building, and possibly a weather enclosure over the underground tanks.

A new DST is shown in Figure 2-4. Each DST would be comprised of two concentric structures: (1) a steel primary tank to contain the radioactive waste materials, and (2) an outer reinforced concrete confinement structure designed to sustain all loads and lined with a secondary steel liner to confine leakage. An annular space would separate the secondary liner from the primary tank. This space would allow for ventilation piping, pumping equipment, and installation of leak detection devices and inspection equipment.

A supporting pad would be placed between the bottom of the primary tank and the secondary confinement structure. The support pad would be slotted to provide passages for the annulus ventilation airflow, in service ultrasonic inspection devices to monitor tank integrity, and thermocouples for temperature monitoring (the thermocouples would be placed on the primary tank, in the annulus, and in the confinement structure). Numerous overhead penetrations in the primary tank and annulus would be provided to support the transferring and mixing of waste and monitoring. The design life of each DST would be 50 years. Monitoring would include the following:

- In-tank temperatures
- Tank wall, bottom, and concrete temperatures
- Corrosion rates
- Tank pressure (vacuum)
- Hydrogen, carbon monoxide, hydrogen sulfide, carbon disulfide, carbon tetrachloride, benzene, acetone, butyl alcohol, methane, methyl butyl ketone, methyl isobutyl ketone, tri-butyl phosphate, normal paraffin hydrocarbons, ammonia, nitrous oxides (NOx), and total hydrocarbons/flammability
- Stack gas monitoring for total hydrocarbons and alpha/beta/gamma radiation
- Stack gas sampling and laboratory analysis for tritium, iodine (^{129}I), and alpha/beta/gamma radiation
- Annulus leak detection
- Pit leak detection.

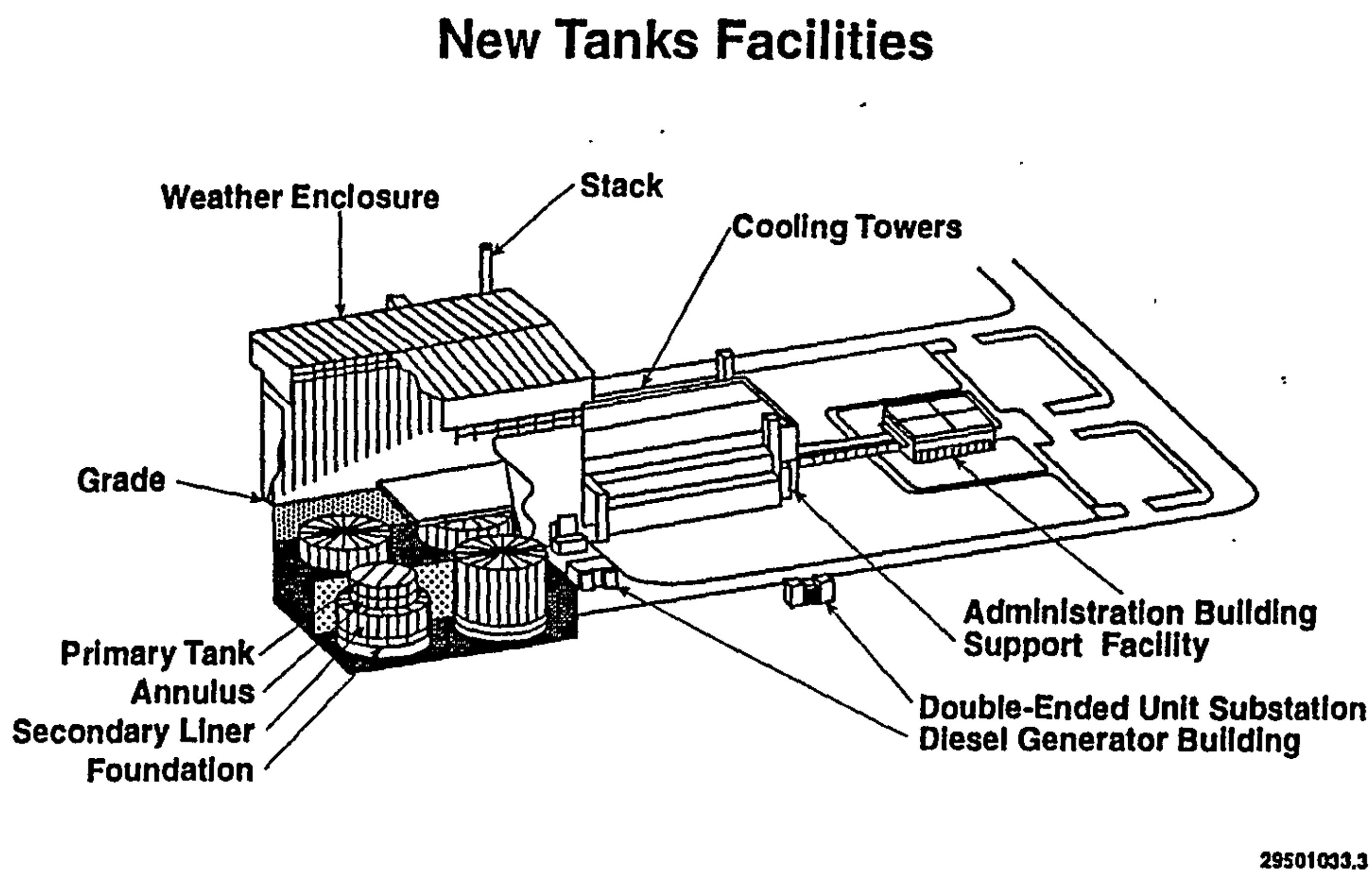
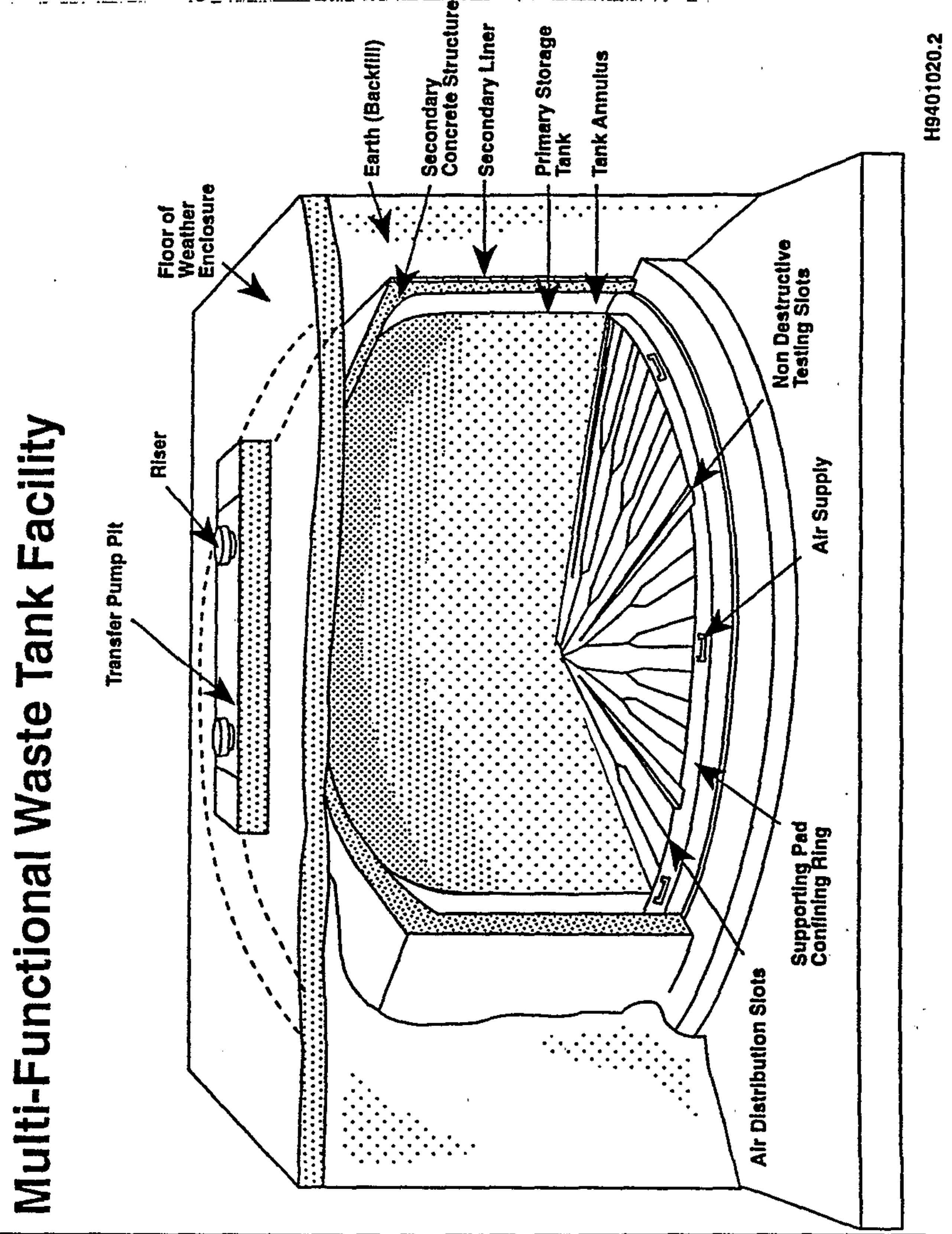


Figure 2-3. Illustration of Replacement Double-Shell Tanks and Support Facilities.

Figure 2-4. Illustration of a Proposed Double-Shell Tank.



The tank ventilation systems would remove heat generated in the tanks. Each tank would have two heat-removal systems: a primary tank ventilation system and annulus ventilation system, as described in the following paragraphs.

Primary Tank Ventilation System - The primary tank ventilation system would maintain negative pressure in the tank and exhaust noncondensible and combustible gases from the tank vapor space to the atmosphere after the gases have passed through moisture-removing and filtering equipment. In sequence, the exhaust would pass through a condenser, high-efficiency mist eliminator filter, electrical heater, high-efficiency metal filter, high-efficiency particulate air filter, high-efficiency gas adsorption filter, and another high-efficiency particulate air filter. (The condenser, high-efficiency mist eliminator, and high-efficiency metal filter backflush water would drain back to a primary tank.)

Annulus Ventilation System - The annulus ventilation system would remove heat from the primary tank walls and floor by convection. The exhaust would pass through two high-efficiency particulate air filters prior to release. A continuous air monitor would be installed in each annulus ventilation exhaust system upstream of the high-efficiency particulate air filters to indicate leakage of radioactive waste material.

After filtration and monitoring, both ventilation systems would exhaust through 30 m (100 ft) stacks (each stack would service a number of tanks). The primary tank ventilation system would be capable of moving air from a nominal 0.14 cubic meters per second (m^3 per second) (300 cubic feet per minute [cfm]) up to 0.45 m^3 per second (960 cfm) of air.

Pipe trenches on each side of each support facility would provide shielded pathways for the primary ventilation piping and other process piping between the waste storage tanks and the process cells. The process cells would contain portions of the primary tank ventilation system equipment. The primary exhaust rooms would contain the final primary tank ventilation exhaust air cleaning units (the high-efficiency particulate air and high-efficiency gas adsorption filters) and exhaust fans, while the annulus exhaust room would contain high-efficiency particulate air filters and exhaust fans associated with the annulus ventilation exhaust system.

The support facilities also would contain operating galleries from which local control and monitoring of the primary tank ventilation system would be performed, and one or more rooms for each of the following functions or equipment: liquid sampling, control, communications, process cell supply air filter, air compressor, contaminated solid waste, building exhaust, building heating, ventilation, and air-conditioning (HVAC) supply, normal electrical distribution panels, backup electrical distribution panels, backup electrical motor control centers, condenser cooling equipment, exhaust sampling, and process cell exhaust. The HVAC systems for the support facilities would maintain differential air pressures within the facilities to minimize the potential for the spread of contamination. Up to four ventilation zones would be established such that airflow would be directed from areas with the least potential for contamination to areas with the most potential for contamination.

The weather enclosures would be single volume pre-engineered metal structures designed to go over the underground tanks and would provide an adequate environment for year-round operational and maintenance activities. At the existing tank farms, operations frequently cannot be conducted because of adverse weather conditions, especially high winds. The weather enclosures would be of sufficient height to permit installation and removal of equipment from the tanks.

The process pits and associated ventilation systems would provide secondary confinement of radioactive material and would be ventilated to maintain a slight negative pressure relative to the atmosphere so that contamination remains in the pits. Flow into the pits would be by infiltration through small gaps in the cover blocks. The slight negative pressure would be controlled in each pit by an exhaust damper controlled by a pressure controller. The exhaust ducts from all pits would be connected to exhaust fans and high-efficiency particulate air filter banks with a pre-filter and exhausted through the stack.

The administration building would contain offices, a lunchroom, a nonprotective-clothing changeroom, training rooms, and a communications room.

2.2.3 Transfer Piping

Separate, dedicated incoming and outgoing steel waste transfer lines, with associated spare lines, would connect the new DSTs with the existing facilities and the new evaporator. All process piping, valve pit drain lines, liquid sample lines, drain lines, and primary ventilation system condensate drains would be encased in secondary piping to collect and detect leakage from the primary piping. All process lines would be sloped for free draining to prevent fluid accumulation in traps. Encasement piping would drain into the process pit in which it terminates, and process pits would drain into the tank on which they are constructed. All encased process lines would be equipped with a leak detection system. The buried portions of the process lines would be encased within a protective coating. The insulated double-wall piping system would be installed on a sand bedding in the excavation. The completed pipeline would be encased in polyurethane foam and a fiberglass reinforced-plastic jacket to minimize the temperature drop of a process transfer. Capability for periodic pressure testing of the primary process piping and encasement would be provided.

Valve pits would be constructed of reinforced concrete with stainless-steel liners and have cover blocks or appropriate radiation shielding. The valve pits would be provided with the capability to remove leakage or washdown liquids. The valve pits would have leak detection capability that, through interlocks, automatically would terminate waste transfers if a leak was detected. The surface area surrounding the valve pits would be sloped to direct any water runoff away from the structure.

The transfers would be remotely monitored and controlled with independent local monitoring capability at each valve pit. The electronically interlocked, automatic shutdown system would be capable of automatically de-energizing the transfer system pumps. The conditions that activate the process shutdown system include leak detection, existing area radiation detection, seismic detection, high pressure detection between slurry line isolation valves, high line pressure detection, and shutdown of the DST retrieval systems. When the shutdown system is activated, the transfer system valves would fail in the "as-is" position to allow for drainage and flushing of the system.

2.3 REPLACEMENT EVAPORATORS

The current high-level waste evaporator is a vacuum vertical thermosiphon evaporator that operates by natural circulation of the liquid. The flow is induced by the hydrostatic pressure imbalance between the liquid in the downcomer and the two-phase mixture in the reboiler tubes. The heat to the reboiler tubes is supplied by steam. Thermosiphons do not require any pump for recirculation (less remote maintenance and down time) and generally are regarded as less likely to foul in service because of the relatively high two-phase velocities obtained in the tubes. A vacuum is drawn on the evaporator, which allows the evaporator to concentrate the liquid while operating at a lower temperature. The vacuum currently is provided by steam jet, which adds approximately 0.0002 m^3 (0.05 gal) of condensate for every 0.004 m^3 (gal) of waste processed.

The new HLW evaporator associated with the retanking is likely to be a vertical thermosiphon evaporator with a blower to provide vacuum instead of a steam jet.

The new DSTs, transfer piping, evaporators, and equipment will be designed in accordance with criteria set forth in DOE Order 6430.1A (DOE 1989). The governing design documents require consideration of all natural phenomena (i.e., wind, ash, flood, earthquake). The design requires review and approval for compliance with established criteria prior to construction initiation. The design will allow the tank, piping systems, and evaporator to maintain integrity under maximum credible seismic events and high winds.

2.4 INITIAL TANK RETRIEVAL SYSTEMS

Hardware items associated with the initial tank retrieval system include mixer pumps, transfer pumps, booster pumps, jumpers, dilution systems, tank cooling systems, instrumentation, new pump pits, and modifications to existing valve and pump pits. Two mixing pumps and one transfer pump would be installed in each DST. Cranes would be needed for installation/removal of equipment and a receiver/bagging system would be needed for the equipment as it is removed.

The retrieval process would begin by pumping the supernate in existing DSTs to new DSTs. Retrieval medium would then be added and the mixer pumps would be operated at full speed until the tank contents are thoroughly mixed and transfer could begin. Retrieval medium might consist either of low-level radioactive liquid waste, evaporator condensate, or chemically adjusted water supplied by the Hanford water system. During the transfer, the mixer pumps would be operated intermittently at reduced speed to keep particulate suspended. After the mixing operations are completed, a transfer pump in a separate tank riser would be used to remove the waste from the tank and circulate wastes through the heat exchanger for the tank. An operator station would be provided to monitor and control the retrieval systems for each tank. Instrumentation would measure the effects and results of mixer pump operation and the physical characteristics of the waste prior to transfer. A dilution system would bring waste properties into compliance with transfer line specifications.

The diluted waste would be transferred to the new evaporator where the dilution water would be recovered for recycle to the tank retrieval process. Approximately 30,000 m^3 (8 million gal) of water would be used in the retrieval and recycle system (3-to-1 dilution of two 3,800 m^3 [1 million gal] tanks). The concentrated waste would be transferred from the evaporator to one of the new DSTs. The evaporator steam condensate and the recovered retrieval water (at the end of the retrieval) would be sent to the liquid effluent treatment facility. The retrieved waste would be as concentrated as the original waste so there would be no net increase in the volume of waste to be stored (estimated to be 104,000 m^3 [27.5 million gal] after terminal clean out) (Koreski and Strode 1994).

Operation of the mixing pumps would increase tank waste temperature and mechanically agitate the waste. Both of these phenomena would tend to increase radiological and hazardous material airborne concentrations in the tank headspace. However, a cooling system, which would be included as part of the initial tank retrieval system and existing DST exhaust filtration components, would prevent any significant increase in routine emissions from current DST ventilation systems.

This page intentionally left blank.

3.0 PERMITS AND REGULATORY REQUIREMENTS

It is the policy of the DOE to carry out its operations in compliance with all applicable Federal, state, and local laws and regulations. This section provides a discussion of the major regulatory permit programs that could be applicable to the proposed action.

3.1 SOLID WASTE REGULATIONS

The new DSTs would be subject to the Resource Conservation and Recovery Act of 1976 (RCRA) permitting requirements for storage of hazardous waste. A Notice of Intent would be submitted to the Washington State Department of Ecology (Ecology) for expansion of the Hanford Site waste tank permit application. Specifics and timing of the permitting activities would be determined during project definitive design. This effort would also require a revision to the existing *Double-Shell Tank System Dangerous Waste Permit Application* (DOE/RL 1991). The new application for these new DSTs would include a discussion of the new transfer piping.

The emptied DSTs would be closed under an approved RCRA closure plan and require post-closure permitting. The DST closure will also meet the requirements of the Dangerous Waste Regulations (WAC 173-303-610). The details of closing a DST are in Section 3.0 of the *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Kline et al. 1995). Permitting the DSTs or SSTs as a final waste form would violate the Code of Federal Regulations (10 CFR 61.55) for near-surface disposal which must contain less than 100 nanocuries per gram transuranic waste. Therefore, this alternative would require some form of regulatory waiver.

3.2 AIR EMISSION REGULATIONS

The U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards under the authority of the *Clean Air Act of 1977* as amended (42 USC 7401). The State of Washington has established emission criteria and ambient air quality standards that are at least as stringent as national criteria. Background levels of total suspended particulate concentrations and emissions of radionuclides and nitrogen oxide are monitored routinely (PNL 1994b). Hanford Site radioactive stacks, including those at existing waste storage tank facilities and the existing high-level waste evaporator, have been registered with the State of Washington Department of Health, Office of Radiation Protection. The Department of Health has issued a Radioactive Airborne Emissions Program permit (FF-01) to the DOE, Richland Operations Office (RL) for the Hanford Site. New sources of nonradioactive air emissions must be approved by Ecology.

Air emissions from the new DSTs, the new high-level waste evaporator, and the 200 Area Effluent Treatment Facility (ETF) would comply with National Emissions Standards for

Hazardous Air Pollutants and Toxic Air Pollutants permit administered by the EPA, the Radioactive Airborne Emissions Program permit administered by the Department of Health, and the nonradioactive air permit administered by Ecology.

3.3 WATER EMISSION REGULATIONS

The water used to retrieve the waste sludges will be recovered in the new high-level waste evaporator. The recovered retrieval water will be recycled to the DSTs for reuse in retrieval until the end of the retanking. At the end of the retanking, the high-level waste evaporator will discharge the condensate to a 200 Area Effluent Treatment Facility (ETF). Two waste water permits will be required for the ETF, a State Waste Discharge Permit and a Septic System Permit. The following describe the general waste water permitting requirements.

A State Waste Discharge Permit will be required for discharge of industrial waste water to the land surface/subsurface. The treated effluent from the ETF is planned to be discharged to a state-approved land disposal site. The ETF and the state-approved land disposal site collectively, or individually, will meet the definition of a waste water facility and the effluent from the ETF will meet the definition of industrial waste water. Ecology requires that all known, available, and reasonable treatment methods be evaluated and demonstrated for the ETF. Refer to the *Permitting Plan for the 200 Area Effluent Treatment Facility* (Skurla 1993) for more information on emission regulations for the ETF.

The domestic waste water generated at the new tank farm facilities and at the ETF will be disposed of to a permitted septic system. Plans and specifications for the sanitary sewer system must be submitted to the Department of Health for approval before construction. After installation, an authorized engineer must certify that the sewer system has been installed in accordance with the plans and specifications approved by the Department of Health.

4.0 CONSTRUCTION

4.1 CONTAMINATED SOILS ENCOUNTERED DURING CONSTRUCTION

During the site selection process, one of the factors to be considered is whether contaminated materials will need to be encountered, disturbed, or moved (e.g., soils) during construction. If a site is selected where contaminated materials will be encountered, disposal methods will need to be employed. For the purposes of this document, it is assumed that no contaminated materials will be encountered during construction.

4.2 EARTHEN BORROW MATERIAL

Earthen borrow material for construction of the processing facilities and ancillary buildings will be located within a 3 kilometer (1.9 mile) radius of the construction site.

Restoration plans for the borrow area and other disturbed areas include revegetation and reseeding to allow habitat renewal.

4.3 CONSTRUCTION NOISE

Construction noise will not exceed Occupational Safety and Health Administration (OSHA) and other regulatory requirements. The effects of construction noise both onsite and offsite will need to be considered during the site selection process.

This page intentionally left blank.

5.0 DATA TABLES

The calculations and/or calculation methods used to obtain the numbers in the tables will be footnoted where possible. Materials referenced in the footnotes may include publicly released documents, other tables, environmental assessments, cost estimates of the Multi-Function Tank Waste Facility, and a new high-level waste evaporator, as well as best engineering judgement. If engineering judgement is used, the rational for the judgement will be outlined in the footnotes. If the rational, the calculation, and/or the calculation methods are too complex to be footnoted, they will be documented in the Appendices.

5.1 DATA ACCURACY

Data accuracy is defined as the delta range expected between a calculated or estimated value to the actual value. Unfortunately, it is impossible to define the accuracy of the data contained in the tables because of the technical uncertainties that surround it. Therefore, rather than use data accuracy, the preparer of the data packages (Westinghouse Hanford Company) will ensure that there is consistency between the data packages for comparison purposes. All values in the tables have been adjusted to two significant figures.

5.2 COMPARATIVE TABLES

5.2.1 Inventory Table

Table 5-1 gives the average radionuclide inventory in a qualified final solid waste form and is included to be consistent with the other data packages. Compared to the other alternatives, there is no qualified final solid waste form that is part of the No Disposal Action alternative. Hence, this table is not applicable to this alternative. Refer to the *Single-Shell and Double-Shell Tank Waste Inventory Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Golberg 1995) for a current estimate of the radionuclide inventory in the Hanford waste tanks.

Table 5-1. Average Radionuclide Inventory in the Final Waste Form (Ci/m^3)[1].

Radionuclide Inventory	High-Level Waste and Low-Level Waste Glass
^{241}Am	n/a
^{243}Am	n/a
^{244}Cm	n/a
^{137}Cs	n/a
^{3}H	n/a
^{63}Ni	n/a
^{237}Np	n/a
^{238}Pu	n/a
^{239}Pu	n/a
^{240}Pu	n/a
^{241}Pu	n/a
^{106}Ru	n/a
^{151}Sm	n/a
^{126}Sn	n/a
^{90}Sr	n/a
^{99}Tc	n/a
^{233}U	n/a
^{234}U	n/a
^{235}U	n/a
^{238}U	n/a
^{93}Zr	n/a
Total	n/a

Notes:

[1]No qualified final solid waste forms are produced with this alternative.

For a current estimate of the radionuclide inventory in the Hanford waste tanks see, *Single-Shell and Double-Shell Tank Waste Inventory Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Golberg 1995).

Golberg, C. E., 1995, *Single-Shell and Double-Shell Tank Waste Inventory Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-102, Rev 0, Westinghouse Hanford Company, Richland, Washington.

5.2.2 Operating Tables

Table 5-2 presents the operating personnel requirements associated with tank farms operations and maintenance, broken down into its lower-level elements--tank farm operations and evaporator operations. This table does not include operating personnel for waste retrieval and tank farm closure.

Table 5-3 presents the operating personnel requirements for the continued operation of the tank farms and a new high-level waste evaporator used during the retanking of the DSTs. The person-hours required are based on continued monitoring and maintenance at the current staffing levels in the tank farm and current staffing levels of the 242A Evaporator.

Table 5-4 presents the operating resources requirements expected for the No Disposal Action alternative. The footnotes on the table indicate the basis for these projections.

Table 5-5 presents the estimates of the various expected nonradiological operating emissions. The No Disposal Action alternative mostly involves releases associated with the maintenance of the Hanford Site in general (i.e., steam supply, etc.).

Table 5-6 presents the radiological operating emissions expected for 100 years from the tank farms and the operation of the evaporators for the three main processing contributors. The most significant isotopes for the No Disposal Action alternative include ^{137}Cs, ^{3}H, ^{129}I, and ^{90}Sr.

Table 5-7 lists the transportation requirements to support processing. Road paving material would be the only requirement for the No Disposal Action alternative.

Table 5-2. Operating Personnel Requirements (Staff-Hours) by Unit Operation[1].

Unit Process	No Disposal Action
Tank farm operations	159,000,000
Evaporator operations	5,000,000
Total (staff hours)	164,000,000

Notes:

[1]See Table 5-3 for basis of estimate of staffing. Based on the TWRS multi-year program plan, evaporator operations are estimated at 1,548 staff years through 2007, plus 1,240 staff years for 10 years of evaporation campaigns for retanking. The breakdown by worker category as shown in Table 5-3 is assumed to apply in equal proportions to the two unit processes listed in Table 5-2.

Table 5-3. Operating Personnel Requirements (Staff-Hours).

Operating Personnel	No Disposal Action[1]
Nonexempt	
Radiation worker	72,000,000
Nonradiation worker	15,000,000
Exempt	
Radiation worker	15,000,000
Nonradiation worker	61,000,000
Total (staff-hours)	164,000,000

Notes:

[1]The operating staff in this table refer to the monitoring and maintaining of the tank farms and operation of the evaporator. The values are based on estimated staffing levels for tank farms operations and maintenance (excluding SST stabilization) from the 1995 TWRS multi-year program plan (extrapolated for 100 years). Breakdown of this overall staffing into the personnel categories indicated is based on current staffing. Twenty percent of current exempt staff are radiation workers. Non-exempt bargaining unit personnel are assumed to be radiation workers. Other non-exempt personnel are assumed to be nonradiation workers. Staffing head count is converted to staff hours at the rate of 1,812 hours per person per year.

Table 5-4. Operating Resource Requirements (Units As Indicated).

Operating Resource	No Disposal Action
Land (m^2) Surface committed permanently	 314,000[1]
Water (m^3) total Raw water (m^3) Sanitary water (m^3)	2,000,000 0 2,000,000[2]
Energy Electrical (GWh) Diesel fuel (m^3)	 1,100[3] 22[4]

Notes:

GWh = gigawatt hour
m^2 = square meter
m^3 = cubic meter

[1]Currently constructed tanks occupy 126,000 m^2 of surface area (RHO 1985). The amount of permanent surface area committed for the new double-shell tanks was factored from the *Draft Environmental Impact Statement for Safe Interim Storage of Hanford Tank Waste* (DOE/EIS-0212). The surface area for weather enclosure was factored to cover 26 tanks (7 weather closures) rather than 4, and the surface area for the support facility and administration facility were added. The total surface area for these facilities was then doubled to account for 2 retankings, and the amount of land for pavement was added (assumed to remain the same). Therefore, current surface area (126,000 m^2) plus the surface area required for the new double-shell tanks (188,000 m^2) equals 314,000 m^2.

[2]See Appendix C for calculation of water usage.

[3]Tank Farms currently uses 11GWh per year (Mercado 1995). Therefore electrical use for 100 years would be 1,100 GWh.

[4]The values for diesel fuel requirements were taken from *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS* (RHO 1985).

DOE, 1994, *Draft Environmental Impact Statement Safe Interim Storage of Hanford Tank Wastes, DOE/EIS*, DOE/EIS- 0212, U. S. Department of Energy, Richland Operations Office, Richland, Washington.

Mercado, L. C., Westinghouse Hanford Company, Personal communication to C. D. Meng regarding current 242A Evaporator staffing levels and Tank Farms operations and maintenance staffing levels and tank farm electrical usage, February 7, 1995.

RHO, 1985, *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington.

Table 5-5. Nonradiological Operating Emissions
(Units as Indicated).

Item	No Disposal Action[1]
Thermal releases	1.1×10^{13} J
Particulate	20 kg
Volatile organic compounds	68 kg
Fugitive dust	n/a
Toxic Air Pollutants[2]	not available
NOx (as nitrogen dioxide)	77 kg
SOx (as sulfur dioxide)	12 kg
Carbon Monoxide	710 kg

Notes:

J = joule
kg = kilogram

[1]The values for these emissions (over the 100-year period) were taken from RHO-RE-ST-30 P, Table 4-17, pages 4-24 and 4-25 (*Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS.*

[2]The list of Toxic Air Pollutants present in the tank farms has not been completed yet. The final list will include only those species that are present in sufficient quantities to be regulated. Vapor characterization of Tank 241-C-103 head space is being used as a worst case to estimate the amount of Toxic Air Pollutants given off by the tank farms. The data for the Toxic Air Pollutants will be in the soon to be released Draft Tank Farms Air Operating Permit.

RHO, 1985, *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington.

Table 5-6. Radiological Operating Emissions (Ci).

Radionuclide(1)	No Disposal Action		
	Air Emissions from Tank Farms(2)	Air Emissions from Evaporator(3)	Water Emissions from Evaporator(4)
^{241}Am	0	n/a	0
^{14}C	0	n/a	0
^{137}Cs	2.1E-03	n/a	1.8E-02
^{3}H	Below Detection(5)	n/a(6)	2.1E02
^{129}I	4.6E-03	n/a	2.7E-02
^{239}Pu, ^{240}Pu	0	n/a	0
^{106}Ru	0	n/a	0
^{151}Sm	0	n/a	0
^{90}Sr	3.1E-04	n/a	2.0E-02
^{99}Tc	0	n/a	0
^{93}Zr	0	n/a	0
Total Alpha	n/a	2.1E-05	n/a
Total Beta	n/a	1.2E-05	n/a
Percent PM-10(7)	100	n/a	n/a

Notes:

1All values in Ci except for percent PM-10.

2Starting air releases for tank farms were taken from WHC-EP-0527-3, *Environmental Releases for Calendar Year 1993* (Thomas and Curn 1994). The release values were then decayed and summed over the 100-year period (see Appendix B).

3These releases were below the trip point for reporting individual radionuclides so total alpha and beta were reported in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas* (Coony et al.).

4These releases were based on the yearly releases of the evaporator while processing approximately 41,600 m^3 (11 million gal) of waste in a year as reported in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas* (Coony et al.). To evaporate 416,000 m^3 (110 million gal) of waste (at a 3-to-1 dilution) at 41,600 m^3 (11 million gal) a year, requires the equivalent of 10 years of operation for each retanking or 20 years of emissions at this level. The releases were calculated by decaying the 1987 releases to the point of evaporation and summing the releases over the evaporator operation while decaying the radionuclide during the evaporation (see Appendix B). The actual evaporation for retanking is scheduled for 5 years each time so the emissions may be more concentrated while remaining within release limits.

Table 5-6. Radiological Operating Emissions (Ci).

Notes: (Continued)

[5]Table 2-1 of the *Environment Releases for Calendar Year 1993* (Thomas and Curn 1994) indicates that air sampling was not done for tritium in the 200 Areas based on its known absence or extremely low concentrations and dose impact.

[6]No separate air emissions were compiled for different radionuclides in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management report for 1987: 200/600/1100 Areas* (Coony et al.); therefore, the tritium releases are contained in the total Beta entry in this column.

[7]Percent PM-10 is 100 percent as all released particulates are less than 10 microns.

Coony, F. M., D. B. Howe, and L. J. Voigt, 1988, *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas*, WHC-EP-0141, Westinghouse Hanford Compant, Richland, Washington.

Thomas S. J. and B. L. Curn, 1994, *Environmental Releases for Calendar Year 1993*, WHC-EP-0527-3, Westinghouse Hanford Company, Richland, Washington.

Table 5-7. Transportation in Support of Processing (Units As Indicated).

Item	No Disposal Action
Normal Operation Route location (state mileage)	Portland/Seattle (400 km)
Road type (gravel or asphalt)	Asphalt
Number of trips per year Truck Train	 n/a n/a
High-Level Waste Transportation Route location (state mileage)	 n/a
Number of canisters	n/a
Number of trips total Train	 n/a

Note:

There is no processing in this alternative so this table is not applicable.

5.2.3 Construction Tables

Table 5-8 lists construction personnel requirements. The personnel required for the No Disposal Action alternative would involve the construction of new double-shell tanks and associated evaporators. This table does not include construction associated with waste retrieval or tank farm closure.

Table 5-9 gives the construction resource requirements for the No Disposal Action alternative. These requirements stem from the construction of replacement double-shell tanks and evaporators.

Table 5-10 lists the nonradiological construction emissions anticipated for the No Disposal Action alternative. This table was factored by a ratio of the total construction cost to the No Separations alternative which had extensive calculations done by Fluor Daniel.

Table 5-11 lists the transportation of earthen borrow material during the replacement tank construction part of the No Disposal Action alternative. This table was factored by a ratio of the total construction cost to the No Separations alternative which had extensive calculations done by Fluor Daniel.

Table 5-12 shows the estimated transportation of other construction material in the Hanford Site for the No Disposal Action alternative. This table was factored by a ration of the total construction cost to the No Separations alternative which had extensive calculations done by Fluor Daniel.

Table 5-8. Construction Personnel Requirements (Staff-Hours) by Unit Process.

Unit Process	No Disposal Action
New double-shell tanks and evaporator[1]	7.5×10^6

Notes:

[1]Construction personnel requirements were factored from the *Title I Design Report Summary Report, Multi-Function Waste Tank Facility Project W-236A*, (KEHC 1994) with additions made for the evaporator and piping connections. The entry reflects retanking the waste twice.

KEHC, 1994, *Title I Design Summary Report, Multi-Function Waste Tank Facility Project W-236A*, WHC-SD-W236A-RPT-002, CR-9996, Vol. 1, Kaiser Engineers Hanford Company, Richland, Washington.

Table 5-9. Construction Resource Requirements (Units As Indicated).

Construction Resource	No Disposal Action
Land (m^2)	
Surface committed	
Temporarily	360,000[1]
Permanently	190,000[2]
Water (m^3)[3]	17,000
Energy[3]	
Electrical (GWh)	0.4
Propane (m^3)	7,500
Diesel fuel (m^3)	63
Gasoline (m^3)	86
Materials[4]	
Concrete (m^3)	120,000
Steel	
Carbon steel (t)	12,000
Stainless steel (t)	22
Hastelloy (t)	0
Excavation (m^3)	3,700,000
Riprap (m^3)	0
Structure backfill (m^3)	3,500,000[5]
Total contaminated material (m^3)	0

Table 5-9. Construction Resource Requirements (Units As Indicated).

Notes:

GWh = gigawatt hour
m^2 = square meter
m^3 = cubic meter
t = metric tons

[1]The amount of temporary surface committed was taken from the *Draft Environmental Impact Statement for Safe Interim Storage of Hanford Tank Wastes*, DOE/EIS-0212 (DOE 1994), pages 3-17 and 3-20.

[2]The amount of permanent surface area committee was factored from the Draft Environmental Impact Statement for Safe Interim Storage of Hanford Tank Wastes, DOE/EIS-0212, pages 3-22 through 3-24. The surface area for weather enclosure was factored to cover 26 tanks (seven weather enclosures) instead of four and the surface area for the support facility and the administration facility were added. The total surface area for these facilities was then doubled to account for two retankings and the amount of land for pavement was added (assumed to remain the same).

[3]Values for water and energy requirements were taken from Table 4-12, pages 4-14 and 4-15 of the *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS* (RHO 1985).

[4]The amount of concrete, steel, and excavation required was factored from the *Title I Design Summary Report, Multi-Function Waste Tank Facility Project W-236A* (KEHC 1994) with additions made for the evaporator and piping connections. Excavation represents structural excavation for new tank construction. The amount of stainless steel was taken from Table 4-12, pages 4-14 and 4-15 of the *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*. The entries reflect retanking the waste twice.

[5]Structure backfill is at the new tanks (excavation minus the volume of the new tanks).

KEHC, 1994, *Title I Design Summary Report, Multi-Function Waste Tank Facility Project W-236A*, WHC-SD-W236A-RPT-002, CR-9996, Vol. 1, Kaiser Engineers Hanford Company, Richland, Washington.

DOE, 1994, *Draft Environmental Impact Statement Safe Interim Storage of Hanford Tank Wastes*, DOE/EIS, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

RHO, 1985, *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington.

Table 5-10. Nonradiological Construction Emissions (units as indicated).

Construction Emission Pollutant	No Disposal Action[1]
Particulate (kg)	130,000
SO_x as sulfur dioxide (SO_2) (kg)	16,000
Carbon monoxide (kg)	36,000,000
Hydrocarbons (kg) (exhaust and fugitive)	1,800,000
NO_x as nitrogen dioxide (NO_2) (kg)	1,900,000
Aldehydes (kg) (as HCHO)	59,000
Organic acids (kg)	0
Thermal releases (J)	7.60×10^{14}
Fugitive dust (t)	550

Notes:

J = joule
kg = kilogram
NO_x = Nitrous oxides
SO_x = Sulfurous oxides
t = metric ton

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

Table 5-11. Transportation of Earthen Borrow Construction Material (Units as Indicated).

Item	No Disposal Action
Borrow source location (state)	3 km NW of site
Route location (state mileage)	Route 3 to Route 4 (5 Km)
Road type (gravel or asphalt)	Gravel, level
Total number of trips Truck[1] Train Barge	 31,000 0 0
New road construction (miles)	0
Load volumes (m^3)	6.1

Notes:

km = kilometer
m^3 = cubic meter
NW = northwest

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

Table 5-12. Transportation of Other Construction Material (Units as Indicated).

Item	No Disposal Action
Route location (state mileage)	Kennewick (70 km)
Total number of trips Truck Train Barge	 20,000 0 0
Route location (state mileage)	Portland/Seattle (400 km)
Total number of trips Truck Train Barge	 7,700 0 0

Notes:

km = kilometer

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

5.2.4 Monitoring and Maintenance Table

Table 5-13 presents the estimates of the total staff-hours required for monitoring and maintenance of the wastes after the disposal action has been completed. There is No Disposal Action in this alternative; therefore, this table does not apply to this alternative.

5.2.5 Decontamination and Decommissioning Tables

Table 5-14 shows that there would be no decommissioning of any noncontaminated facilities for the No Disposal Action alternative.

Table 5-15 reveals that the decontamination and decommissioning of contaminated treatment/storage facilities applies to the evaporators built as part of the No Disposal Action alternative. The emptied double-shell tanks would be filled with local grout or gravel.

5.2.6 Cost Tables

Table 5-16 reveals that all of the anticipated process module capital costs of the No Disposal Action alternative would be associated with replacement double-shell tanks and evaporators.

Table 5-17 presents the estimated overall cost components for the No Disposal Action alternative. The largest items involve the capital associated with new tanks and evaporators and the ongoing operating cost of monitoring and maintaining the tank farms.

Table 5-18 gives the breakdown of the projected capital costs for the No Disposal Action alternative. The largest single item is for the labor involved in replacement tank construction.

Table 5-19 lists the projected monitoring and maintenance cost components of the wastes after the disposal action has been completed. There is no disposal action in this alternative and institutional control is expected to be lost after 100 years; therefore, this table does not apply to this alternative.

Table 5-20 gives the projected operating costs of the No Disposal Action alternative. These costs include the labor to monitor and maintain the tank farms and site as well as the evaporators. Costs for site control were included in the overhead of the operating costs.

Table 5-13. Monitoring and Maintenance Personnel Requirements (Staff-Hours).

Operating Personnel	No Disposal Action[1]
Nonexempt	
Radiation worker	n/a
Nonradiation worker	n/a
Exempt	
Radiation worker	n/a
Nonradiation worker	n/a
Total	n/a

Note:

[1]This table refers to the monitoring and maintenance of the qualified final solid waste form after processing is completed. This alternative has no qualified final solid waste form and it is assumed that there is no institutional control after the 100 years; therefore, this table does not apply to this alternative.

Table 5-14. Decommissioning of Non-Contaminated Treatment/Storage Facilities (Metric Kilo-Tons).

Item	No Disposal Action
Steel	
Quantity	n/a
Disposition	n/a
Concrete	
Quantity	n/a
Disposition	n/a
Soil	
Quantity	n/a
Disposition	
Debris	
Quantity	n/a
Disposition	n/a

Note:

No noncontaminated treatment/storage facilities would be constructed or operated in this alternative.

Table 5-15. Decommissioning of Contaminated Treatment/Storage Facilities (Metric Kilo-Tons).

Item	No Disposal Action
Steel Quantity Disposition	 20 t Low-level waste burial ground
Concrete Quantity Disposition	 150 m^3 Low-level waste burial ground
Soil Quantity Disposition	 0
Debris Quantity Disposition	 140 m^3 Low-level waste burial ground

Notes:

m3 = cubic meters
t = metric tons

As a part of this alternative, the current double-shell tanks and the new double-shell tanks would be left in place; therefore, no decontamination and decommissioning work would be done on them. The abandoned double-shell tanks may be filled with grout or gravel. Details of the closure of the double-shell tanks are in the *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study* (Kline et al. 1995)

The two high-level waste evaporators built as part of this alternative would be decommissioned. The entries in this table are for those evaporators. The following assumptions were made for decommissioning: 5 percent of the concrete and steel will remain contaminated; 85 percent of the stainless steel will remain contaminated; 5 percent of the decontaminated steel and concrete will be debris; and the evaporators will be entombed in place so no contaminated soil would need to be removed.

Kline, P. L., H. Hampt and W. A. Skelly, 1995, *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study*, WHC-SD-WM-EV-107, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 5-16. Overall Cost by Unit Process Module (Millions of 1995 Dollars).

Process Module	No Disposal Action
Tank farm operations	$17,540
Evaporator operations	$ 760
Total	$18,300

Table 5-17. Overall Cost Component
(Millions of 1995 Dollars).

Cost Component	No Disposal Action
Capital	$4,000[1]
Operating	$14,300
Monitoring and maintenance	$0[2]
Research and development	$0
Total	$18,300

Notes:

[1]The number of tanks required to retank the projected waste was calculated at 26 (see Appendix A). The Multi-Function Waste Tank Facility project would build six new double-shell tanks. Document TKFCC.XLS9/9/94 (Light 1994) is a tank farm cost comparison which projects the cost of new double-shell tanks up to 18 new tanks in 1997 dollars, including contingency. The costs for six new double-shell tanks were converted to 1995 dollars on 3.5 percent per year deflation. The cost for new tanks was extended from 18 to 26 tanks. The cost estimated for 26 new tanks is $1,674 million dollars. The cost of piping connections from the old to new double-shell tanks is approximately 11 percent (cross-site transfer line compared to new double-shell tanks); therefore, the connecting piping will cost $184 million dollars. Document ADM-W-92-12-253 (Kaiser Engineers Hanford) contains an estimate in 1992 dollars to build a new evaporator. The cost (before contingency) was inflated to 1995 dollars (3.5 percent per year) and a 40 percent contingency was used to be consistent with the other data packages. A new evaporator costs $163 million (1995 dollars) to build.

Total capital costs are $1,674 million + $184 million + $163 million = $2,021 million dollars each time retanking is done. The waste would be retanked twice; therefore, total capital costs for the 100 years in 1995 dollars is $4,000 million dollars.

[2]Monitoring and maintenance cost is zero as there would be no qualified final solid waste form to monitor. Labor for tank monitoring and maintenance in the tank farms is covered in the operating cost until loss of institutional control in 2095.

Light, J. M., 1994, *Tank Farm Cost Comparison for New Tanks Based on the Cost of the Multi-Function Waste Tank Facility* (Document TKFCC.XLS9/9/94 to C. D. Meng, December 9, 1994), Westinghouse Hanford Company, Richland, Washington.

Table 5-18. Capital Cost Component (Millions of 1995 Dollars).

Capital Cost Component	No Disposal Action
Labor	$2,400[1]
Materials and supplies	$1,040[1]
Equipment	$ 330[1]
Local purchases	$ 230[2]
Total	$4,000

Notes:

[1]Percentages of total cost were taken from the preliminary cost estimate (construction portion) of the *Multi-Function Waste Tank Facility (MWTF) Preliminary Estimate (Title I) DOE-R01 - Project Cost Summary* (Job No. W236A/CR9996, File No. W236PAA2, ICF Kaiser Hanford Company and Westinghouse Hanford Company, Richland, Washington.

[2]Assumed to be 18 percent of total materials and supplies and equipment purchases, based on Westinghouse Hanford Compant 1994 procurement.

Table 5-19. Operating Cost Component (Millions of 1995 Dollars).

Operating Cost Component	No Disposal Action
Labor	$13,730[1]
Materials/supplies	$ 570[2]
Equipment	$ 0
Local purchases	$ 100[3]
Total	$14,300

Notes:

[1]Labor is assumed to compose the entire estimated operating cost, except materials and supplies. The total estimated operating cost is based on the TWRS multi-year program plan projections for tank farm operations and maintenance, excluding SST stabilization, and extrapolated to the end of the 100 year operating period.

[2]Materials and supplies are estimated at 4 percent of the total operations and maintenance cost, based on FY 1995 actual expenditures as reported on the WHC financial data system (FDS).

[3]Assumes that 18 percent of materials and supplies would be purchased locally, based on 1994 expenditures. Local purchases are included in the Materials/Supplies category.

Boomer, K. D., J. M. Colby, T. W. Crawford, J. S. Garfield, C. E. Golberg, C. E. Leach, D. E. Mitchell, F. D. Nankani, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, and C. M. Winkler, 1994, *Tank Waste Remediation System Facility Configuration Study*, WHC-SD-WM-ES-295, Rev. 0, Westinghouse Hanford Company, Richland, Washington).

Table 5-20. Monitoring and Maintenance Cost Component (Millions of 1995 Dollars).

Monitoring and Maintenance Cost Component	No Disposal Action
Labor	n/a[1]
Materials and supplies	n/a
Equipment	n/a
Local purchases	n/a
Total	n/a

Notes:

[1]This table refers to monitoring and maintaining the final waste form after reprocessing is completed. This alternative has no qualified final solid waste form and assumes that there is no institutional control after the 100 years. Therefore, this table does not apply to this alternative. Maintenance of the waste tanks is included in the operating costs.

5.2.7 Schedules and Radiation Dose Tables

Table 5-21 gives the anticipated overall schedule for the completion of the No Disposal Action alternative.

Table 5-22 gives the anticipated construction equipment schedule.

Table 5-23 gives the dose based on the historical average of the tank farms operation with current staff level and an assumed dose rate based on operation of PUREX for doses for the operation of the evaporator at current staff levels. This table does not include doses attributable to waste retrieval or tank farm closure operations.

Table 5-24 does not apply to the No Disposal Action alternative.

Table 5-25 gives the anticipated dates for the two retanking campaigns that would comprise the No Disposal Action alternative.

Table 5-26 gives typical construction durations by-type of activity that would be expected during the No Disposal Action alternative.

Table 5-21. Overall Schedule (Calendar Year Start/Completion Date).

Activity	No Disposal Action[1]
Construction	06/2033 - 06/2037 06/2083 - 06/2087
Tank retrieval and re-evaporation	06/2037 - 06/2042 06/2087 - 06/2092
Decontamination and decommissioning	06/2042 - 06/2047 06/2092 - 06/2097
Monitoring and maintenance	01/1995 - 01/2095
Research and development	n/a

Notes:

[1]Figure 2-2 is a representation of the above schedule.

Table 5-22. Construction Equipment Schedule (units).

Construction Equipment Type	No Disposal Action[1]
Heavy duty diesel equipment	100
Light-duty[2] diesel equipment	230
Light-duty gasoline vehicles	220
Small gasoline engines	650
Construction[3] noise (dcbls)	85

Notes:

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

[2]Light-duty diesel equipment has been added to this chart. It represents diesel engine equipment that runs at idle speed for a major portion of its time (e.g., lift cranes). The number of equipment units is based on a tabulation of "expected" types and numbers of equipment.

[3]Represents noise near a twin-engine scraper with 2 push dozers. The construction noise is based upon the noise at a twin-engine scraper with (2) Dg push cats. The combination produces "border line" ear protection noise levels for the equipment operators. The borderline threshold is 85 decibels. At distances away from the operating equipment, the noise level will decrease.

Table 5-23. Radiation Dose at Facility (mrem) by Unit Process.

Unit Process	No Disposal Action
Tank farm operations	$6.5 \times 10^{5(1)}$
Evaporator operations	$2.9 \times 10^{5(2)}$

Notes:

*Denotes data is outside the scope of this document. Refer to the *Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Fredenburg 1995) and the *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Kline et al. 1995).

[1]Historically, the average occupational dose for a tank farm worker has been 14 millirems per person per year (DOE 1992). The new tanks with enhanced safety features would have less dose associated with them than the historical average. Conservatively assuming the historical average for the new tank farms: 14 millirems (mrem) per year per person x 84,350,00 staff hours x 1 yr/1,812 staff hours = 6.5×10^5 mrem. See Tables 5-2 and 5-3 for basis of estimated staff hours for tank farm operations radiation workers.

[2]Average whole body deep exposure to operational personnel at the PUREX plant during 1986 was 200 mrem per year. Assuming this average is similar to operating the evaporator: 200 mrem per year per person x 2,650,000 staff hours x 1 yr/1,812 staff hours = 2.9×10^5 mrem. See Tables 5-2 and 5-3 for basis of estimated staff hours for evaporator operations radiation workers.

Maximum allowable radiation exposure to a radiation worker is 500 mrem per year.

DOE, 1992, *Environmental Assessment for the Proposed Pump Mixing Operations to Mitigate Episodic Gas Releases in Tank 241-SY-101*, Hanford Site, Richland, Washington, DOE/EA-0803, U.S. Department of Energy, Washington, D. C.

Fredenburg, E. A., 1995, *Waste Retrieval and Transfer Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-097, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kline, P. L., H. Hampt and W. A. Skelly, 1995, *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study*, WHC-SD-WM-EV-107, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 5-24. Radiation Dose at Nearby Facilities (mrem) by Unit Process.

Unit Process	No Disposal Action
Pumping and sluicing	n/a
Hydraulic retrieval	n/a
Sludge wash	n/a
Cesium removal	n/a
Other radionuclide removal	n/a
Low-level waste vitrification	n/a
Low-level waste disposal	n/a
High-level waste vitrification	n/a
High-level waste transportation	n/a
High-level waste disposal	n/a
Emptied single-shell tank closure	n/a
Emptied double-shell tank closure	n/a

Notes:

mrem = millrem

The tank farm and evaporator operators would not be affected by the totally cleaned out facilities in the 200 East and 200 West areas.

Table 5-25. Operating Schedule (Calendar Year Start/Completion Date) by Unit Process.

Unit Process	No Disposal Action[(1)]
Tank retrieval and re-evaporation	06/2037 - 06/2042 06/2087 - 06/2092

Note:

[1]The schedule was taken Figure 3-22, p. 3-30 *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, (RHO 1985).

RHO, 1985, *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington.

Table 5-26. Duration (percent) by Construction Type.

Unit Process	Typical[1]
Clearing	1.6
Grubbing	1.6
Earthwork	4.9
Foundations	7.8
Structure	26
Mechanical and Electrical	29
Piping	29

Note:

[1]The source of this table is the *No Separations Data Package for the Tank Waste Remediation System Environmental Impact Statement*, (Colby 1995).

Colby, S. A., 1995, *No Separations Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-103, Rev. 0, Westinghouse Hanford Compant, Richland, Washington.

This page intentionally left blank.

6.0 REFERENCES

10 CFR 61.55, Waste Classification, Licensing Requirements for Land Disposal of Radioactive Waste, Title 10, *Code of Federal Regulations,* Part 61.55 as amended, U.S. Nuclear Regulatory Commission, Washington, D. C.

42 USC 7401, *Clean Air Act of 1977*, as amended.

Alstad, A.T., 1990, *Criteria for Interim Isolation of Radioactively Contaminated Tank Farm Facilities at Hanford*, WHC-SD-WM-TI-097, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

DOE, 1987, *Environmental Impact Statement for Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes*, DOE/EIS-0113, U.S. Department of Energy, Washington, D.C.

DOE, 1988, *Radioactive Waste Management*, DOE 5820.2A, U.S. Department of Energy, Washington, D.C.

DOE, 1989, *General Design Criteria*, DOE 6430.1A, U.S. Department of Energy, Washington, D.C.

DOE/RL, 1991, *Double-Shell Tank System Dangerous Waste Permit Application*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA and DOE, 1994, Hanford Federal Facility Agreement and Consent Order, 2 vols, as amended, Washington State Department of Ecology, Olympia, Washington, and U.S. Environmental Protection Agency and U.S. Department of Energy, Washington, D.C.

Golberg, C.E., 1995, *Single-Shell and Double-Shell Tank Waste Inventory Data Packaage for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-102, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B.M., 1994, *Tank Farm Surveillance and Waste Status Summary Report - October 1994*, WHC-EP-0182-79, Westinghouse Hanford Company, Richland, Washington.

Interactive Estimating, 1994, *Multi-Function Waste Tank Facility (MWTF) Preliminary Estimate (Title I) DOE-R01 - Project Cost Summary*, Job No. W-236A/CR9996, File No. W236PAA2, ICF Kaiser Hanford Company and Westinghouse Hanford Company, Richland, Washington.

Kline, P. L., H. Hampt and W. A. Skelly, 1995, *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study*, WHC-SD-WM-EV-107, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Koreski, G.M. and J.N. Strode, Westinghouse Hanford Company, Personal communication to C.D. Meng, Westinghouse Hanford Company, Re: Double Shell Tank Waste Volume Projection for 2005, November 30, 1994.

PNL, 1994b, *Environmental Report 1993*, Pacific Northwest Laboratory, Richland, Washington.

RHO, 1985, *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington.

Skurla, S.J., 1993, *Permitting Plan for the 200 Area Effluent Treatment Facility, (Project C018H)*, Westinghouse Hanford Company, Richland, Washington.

Thomas, S.P. and B.L. Curn, 1994, *Environmental Releases for Calendar Year 1993*, WHC-EP-0527-3, Westinghouse Hanford Company, Richland, Washington.

WAC, 173-303-610, 1993, "Closure and Post Closure, Dangerous Waste Regulartion," *Washington Administrative Code*, as amended, Olympia, Washington.

WHC, 1993a, *RCRA Permit for the TSD of Dangerous Waste (at Hanford)*, Dangerous Waste Portion, Permit Number WA7890008967, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

REPLACEMENT TANKS CALCULATIONS AND RETANKING COST CALCULATION

This page intentionally left blank.

APPENDIX A

REPLACEMENT TANKS CALCULATIONS AND RETANKING COST CALCULATION

Replacement Tanks Calculation

This estimate assumes the following:

1. The cut-off year is 2005 and Terminal Clean Out (TCO) of all facilities is complete as scheduled. The volume of waste in the tanks will not change between 2005 and 2037 when the retanking begins. The effluent treatment facility will be operable to handle evaporator condensate, contaminated rain water, snowmelt, etc. laboratory wastes will fit into available tank space. Retanking will require 5 years to accomplish.

2. The W-242A evaporator has been available up to 2005 to concentrate the TCO wastes.

3. The existing tank waste will be combined in the new tanks in such a way as to fill the new tanks to their operating limit.

4. One tank will remain empty as a contingency for a leaking DST (DOE 5820.2A). Aging waste will not be a factor in 2037 during the retanking as another half-life of ^{137}Cs and ^{90}Sr (30 years) will have passed which will reduce the heat load of the waste. Therefore, there will be no aging waste and segregation of the waste into aging waste tanks will not be required. Thus, a separate contingency tank will not be required for aging waste.

5. An evaporator will be provided to concentrate waste after retrieval and before transfer to the new tanks, therefore the same volume will exist in the new tanks.

Waste volume projection for 2005 equals 104,000 m^3 (27.5 million gal) per telephone conversation with G. M. Koreski/J. N. Strode on November 30, 1994.

Operating limit on DSTs constructed after 1974 is 4,300 m^3 (1,140,000 gal) per tank as reported in WHC-EP-0182-75 on Page D-7 (Tank Farm Surveillance and Waste Status Summary Report - July 1994 B. M. Hanlon).

$$\frac{27{,}500{,}000 \text{ gallons}}{1{,}140{,}000 \text{ gallons/tank}} = 24.1 \text{ tanks} = 25 \text{ tanks}$$

25 tanks plus 1 empty tank for contingency = 26 tanks total

Retanking Cost Calculation

Project W-236A would have built new DSTs. Document TKFCC.XLS9/9/94 is a Tank Farm Cost Comparison which projects the cost of new DSTs up to 18 new tanks in 1997 dollars including contingency. The costs for the six new DSTs where converted to 1995 dollars on 3.5 percent per year deflation and the percentage increase for each new tank was extended out to 26 tanks. The cost estimated for 26 new tanks using this approach is 1,674 million dollars.

Current costs for the cross site transfer line is 11 percent of the new tanks. The new tanks need to be connected to the old tanks for retanking. The cost of the piping connecting the new tanks to the old tanks is assumed to be 11 percent of the projected cost of the 26 tanks which is 184 million.

Document ADM-W-92-153, which is titled *Cost Evaluation for the New or Replacement High-Level Waste Evaporator Project*, contains an estimate in 1992 dollars to build a new evaporator. The cost (before contingency) was inflated to 1995 dollars (3.5 percent per year) and a 40 percent contingency was used to be consistent with the other data packages. A new evaporator costs 163 million (1995 dollars) to build.

Total capital costs would be 1,674 + 184 + 163 = 2,021 million each time retanking is done.

The waste will be retanked twice, so total capital costs for the 100 yrs in 1995 dollars is 4,042 million dollars.

APPENDIX B

CALCULATION OF RADIOLOGICAL RELEASES TO AIR AND WATER FROM THE TANK FARMS AND EVAPORATOR OVER THE FIRST 100 YEARS

This page intentionally left blank.

APPENDIX B

CALCULATION OF RADIOLOGICAL RELEASES TO AIR AND WATER FROM THE TANK FARMS AND EVAPORATOR OVER THE FIRST 100 YEARS

The amount of a radionuclide at a given time in its decay life is represented by:

$$N = N^{\circ}\, e^{-\lambda t}$$

where:

- N = the amount of the radionuclide at time t
- N° = the amount of the radionuclide at time zero
- λ = the decay constant

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

- $t_{1/2}$ = the half life or the amount of time before half the original amount of radionuclides decay

To find the amount of environmental releases over a 100-year period the decay equation is integrated over 100 years.

$$\int_0^{100} N^{\circ}\, e^{-\lambda t}\, dt = N^{\circ} \int_0^{100} e^{-\lambda t}\, dt =$$

$$= N^{\circ} \left[\frac{-e^{-\lambda t}}{\lambda}\right]_0^{100} =$$

$$= - N^{\circ} \left[\frac{e^{-\lambda 100}}{\lambda} - \frac{e^{0}}{\lambda}\right] =$$

$$= N^{\circ}\left[\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 100}}{\lambda}\right]$$

$$\text{for } {}^{137}\text{Cs} \quad t_{1/2} = 30 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{30\ \text{y}} = 0.0231\ \text{y}^{-1}$$

$$\text{for } {}^{90}\text{Sr} \quad t_{1/2} = 28.1 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{28.1\ \text{y}} = 0.0247\ \text{y}^{-1}$$

$$\text{for } {}^{129}\text{I} \quad t_{1/2} = 1.7\text{X}10^{7} \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{1.7\text{X}10^{7}\ \text{y}} = 4.08\text{X}10^{-8}\ \text{y}^{-1}$$

Current yearly tank farm air releases are:

$$^{137}\text{Cs} = 5.3 \text{ X } 10^{-5} \text{ Ci}$$

$$^{90}\text{Sr} = 8.4 \text{ X } 10^{-6} \text{ Ci}$$

$$^{129}\text{I} = 4.6 \text{ X } 10^{-5} \text{ Ci}$$

Tank Farm releases for 100 years for each of these radionuclides are:

for ^{137}Cs

$$5.3\text{X}10^{-5}\ \text{Ci}\left[\frac{1}{0.0231} - \frac{e^{-0.0231(100)}}{0.0231}\right] = 2.1\text{X}10^{-3}\ \text{Ci}$$

for ^{90}Sr

$$8.4\text{X}10^{-6}\ \text{Ci}\left[\frac{1}{0.0247} - \frac{e^{-0.0247(100)}}{0.0247}\right] = 3.1\text{X}10^{-4}\ \text{Ci}$$

for ^{129}I

$$4.6X10^{-5}\ Ci[\frac{1}{4.1X10^{-8}} - \frac{e^{-4.1X10^{-8}(100)}}{4.1X10^{-8}}] = 4.6X10^{-3}\ Ci$$

Yearly evaporator liquid releases for 1987 are:

$$^{3}H = 4.30 \text{ X } 10^{2} \text{ Ci}$$

$$^{137}Cs = <4.91 \text{ X } 10^{-3} \text{ Ci}$$

$$^{90}Sr = <6.07 \text{ X } 10^{-3} \text{ Ci}$$

$$^{129}I = <1.36 \text{ X } 10^{-3} \text{ Ci}$$

Yearly evaporator air releases for 1987 are:

Total Alpha = $1.04 \text{ X } 10^{-6}$ Ci

Total Beta, = $3.63 \text{ X } 10^{-6}$ Ci

The first evaporation connected to retanking occurs in 2037. The releases above will be decayed to that time (50 years). The decayed releases then will be summed and decayed over the first ten year operation of the evaporator. The releases then will be decayed to the beginning of the second evaporation which starts in 2087 (another 50 years). The decayed releases then will be summed and decayed over the second ten year operation of the evaporator.

$$N = N^{\circ}\ e^{-\lambda t}$$

where:

N	=	the amount of the radionuclide at time t
N°	=	the amount of the radionuclide at time zero
λ	=	the decay constant

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

$t_{1/2}$ = the half life or the amount of time before half the original amount of radionuclides decay

$$\text{for } {}^{137}\text{Cs} \quad t_{1/2} = 30 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{30 \text{ y}} = 0.0231 \text{ y}^{-1}$$

$$\text{for } {}^{90}\text{Sr} \quad t_{1/2} = 28.1 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{28.1 \text{ y}} = 0.0247 \text{ y}^{-1}$$

$$\text{for } {}^{129}\text{I} \quad t_{1/2} = 1.7\text{X}10^{7} \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{1.7\text{X}10^{7} \text{ y}} = 4.08\text{X}10^{-8} \text{ y}^{-1}$$

$$\text{for } {}^{3}\text{H} \ t_{1/2} = 12.3 \text{ years so } \lambda = \frac{\ln 2}{12.3 \text{ y}} = 0.0564 \text{ y}^{-1}$$

Therefore, the amount of the radionuclides after 50 years is:

for ^{3}H

$$N = 4.3\text{X}10^{2} \text{ Ci } e^{-0.0564(50)} = 25.7 \text{ Ci}$$

for ^{137}Cs

$$N = 4.91 \text{ X } 10^{-3} \text{ Ci } e^{-0.0231(50)} = 1.55 \text{ X } 10^{-3} \text{ Ci}$$

for ^{90}Sr

$$N = 6.07 \ 10^{-3} \text{ Ci } e^{-0.0247(50)} = 1.77 \ 10^{-3} \text{ Ci}$$

for ^{129}I

$$N = 1.36 \text{ X } 10^{-3} \text{ Ci } e^{-4.1 \text{ X } 10^{-8}(50)} = 1.36 \text{ X } 10^{-3} \text{ Ci}$$

for Total Beta (decay the same as ^{90}Sr)

$$N = 3.63 \text{ X } 10^{-6} \text{ Ci } \ e^{-0.0247(50)} = 1.06 \text{ X } 10^{-6} \text{ Ci}$$

for Total Alpha (decay the same as Pu $t_{1/2}$ = 24,400 y $\lambda = 2.84 \times 10^{-5}$)

$$N = 1.04 \times 10^{-6}\ Ci\ e^{-2.84 \times 10^{-5}(50)} = 1.04 \times 10^{-6}\ Ci$$

First evaporator releases over a 10 year period are calculated below:

$$N = N^{\circ}\left[\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 10}}{\lambda}\right]$$

Evaporator releases for 10 years for each of these radionuclides are:

for ^{137}Cs

$$Total = 1.55 \times 10^{-3}\ Ci\left[\frac{1}{0.0231} - \frac{e^{-0.0231(10)}}{0.0231}\right] = 1.38 \times 10^{-2}\ Ci$$

for ^{3}H

$$25.7\ Ci\left[\frac{1}{0.0564} - \frac{e^{-0.0564(10)}}{0.0564}\right] = 196.4\ Ci$$

for ^{90}Sr

$$1.77 \times 10^{-3}\ Ci\left[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}\right] = 1.56 \times 10^{-2}\ Ci$$

for ^{129}I

$$1.36 \times 10^{-3}\ Ci\left[\frac{1}{4.1 \times 10^{-8}} - \frac{e^{-4.1 \times 10^{-8}(10)}}{4.1 \times 10^{-8}}\right] = 1.36 \times 10^{-2}\ Ci$$

for Total Beta

$$1.06 \times 10^{-6}\ Ci\left[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}\right] = 9.36 \times 10^{-6}\ Ci$$

for Total Alpha

$$1.04 \times 10^{-6}\ \mathrm{Ci}\left[\frac{1}{2.84 \times 10^{-5}} - \frac{e^{-2.84 \times 10^{-5}(10)}}{2.84 \times 10^{-5}}\right] = 1.04 \times 10^{-5}\ \mathrm{Ci}$$

The second evaporation will occur after another 50 years of decay. Release concentrations after the second 50 years are:

$$N = N^{o}\, e^{-\lambda t}$$

for ^{137}Cs

$$N = 1.55 \times 10^{-3}\ \mathrm{Ci}\ e^{-0.0231(50)} = 4.87 \times 10^{-4}\ \mathrm{Ci}$$

for ^{3}H

$$N = 25.7\ e^{-0.0564(50)} = 1.53\ \mathrm{Ci}$$

for ^{90}Sr

$$N = 1.77 \times 10^{-3}\ \mathrm{Ci}\ \ e^{-0.0247(50)} = 5.14 \times 10^{-4}\ \mathrm{Ci}$$

for ^{129}I

$$N = 1.36 \times 10^{-3}\ \mathrm{Ci}\ e^{-4.1 \times 10^{-8}(50)} = 1.36 \times 10^{-3}\ \mathrm{Ci}$$

for Total Beta (decay the same as ^{90}Sr)

$$N = 1.06 \times 10^{-6}\ \mathrm{Ci}\ \ e^{-0.0247(50)} = 3.08 \times 10^{-7}\ \mathrm{Ci}$$

for Total Alpha (decay the same as Pu $t^{1/2} = 24{,}400$ y $\lambda = 2.84 \times 10^{-5}$)

$$N = 1.04 \times 10^{-6}\ \mathrm{Ci}\ \ e^{-2.84 \times 10^{-5}(50)} = 1.04 \times 10^{-6}\ \mathrm{Ci}$$

Second evaporator releases over a 10 year period are calculated below:

$$N = N^\circ \left[\frac{e^0}{\lambda} - \frac{e^{-\lambda 10}}{\lambda}\right]$$

Evaporator releases for 10 years for each of these radionuclides are:

for ^{137}Cs

$$4.87 \times 10^{-4}\ \text{Ci}\left[\frac{1}{0.0231} - \frac{e^{-0.0231(10)}}{0.0231}\right] = 4.35 \times 10^{-3}\ \text{Ci}$$

for ^{3}H

$$1.53\ \text{Ci}\left[\frac{1}{0.0564} - \frac{E^{-0.0564(10)}}{0.0564}\right] = 11.7\ \text{Ci}$$

for ^{90}Sr

$$5.14 \times 10^{-4}\ \text{Ci}\left[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}\right] = 4.56 \times 10^{-3}\ \text{Ci}$$

for ^{129}I

$$1.36 \times 10^{-3}\ \text{Ci}\left[\frac{1}{4.1 \times 10^{-8}} - \frac{e^{-4.1 \times 10^{-8}(10)}}{4.1 \times 10^{-8}}\right] = 1.36 \times 10^{-2}\ \text{Ci}$$

for Total Beta

$$3.08 \times 10^{-7}\ \text{Ci}\left[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}\right] = 2.72 \times 10^{-6}\ \text{Ci}$$

for Total Alpha

$$1.04 \times 10^{-6}\ \text{Ci}\left[\frac{1}{2.84 \times 10^{-5}} - \frac{e^{-2.84 \times 10^{-5}(10)}}{2.84 \times 10^{-5}}\right] = 1.04 \times 10^{-5}\ \text{Ci}$$

Total releases for the evaporator is a sum of the first and second evaporator operation releases:
for ^{137}Cs

$$<1.38 \times 10^{-2} + <4.35 \times 10^{-3} = <1.8 \times 10^{-2} \text{ Ci}$$

for ^{3}H

$$196 \text{ Ci} + 12 \text{ Ci} = 210 \text{ Ci}$$

for ^{90}Sr

$$<1.56 \times 10^{-2} + <4.56 \times 10^{-3} = <2.0 \times 10^{-2} \text{ Ci}$$

for ^{129}I

$$<1.36 \times 10^{-2} + <1.36 \times 10^{-2} = <2.7 \times 10^{-2} \text{ Ci}$$

for Total Beta

$$9.36 \times 10^{-6} + 2.72 \times 10^{-6} = 1.2 \times 10^{-5} \text{ Ci}$$

for Total Alpha

$$1.04 \times 10^{-5} + 1.04 \times 10^{-5} = 2.1 \times 10^{-5} \text{ Ci}$$

APPENDIX C

WATER CALCULATIONS

This page intentionally left blank.

APPENDIX C

WATER CALCULATIONS

Retanking water computation

Assume one tank is retrieved and being processed while a second tank is being retrieved. The evaporator condensate from the first tank will be collected and recycled for use in retrieval of the third tank and the second tank evaporator condensate will be used for the fourth tank retrieval, etc. Therefore, the maximum retrieval water for each retanking will be 30,000 m^3 (8 million gal) (3-to-1 dilution). The evaporator condensate of the final two tanks will be sent to the liquid effluent handling facility at the evaporator rate.

The retanking shall occur twice over the 100 years. Total water for retanking is therefore 60,000 m^3 (16 million gallons).

When the water is disposed of to the 200 Area Effluent Treatment Facility (ETF), the evaporator will be running between 0.003 m^3/s (50 gpm) and 0.004 m^3/s (70 gpm) and the ETF will accept 0.01 m^3/s (150 gpm) influent waste water.

Potable water computation

Assume 0.08 m^3 (20 gallons) per day per person plus a 10 percent contingency.

Water usage for tank farm personnel is:

$$\frac{159 \text{ X } 10^6 \text{ hours}}{1{,}812 \text{ hours/person year}} \text{ X } \frac{20 \text{ gallons}}{\text{person day}} \text{ X } \frac{260 \text{ days}}{\text{year}} \text{ X } 1.10 = 5.0 \text{ X } 10^8 \text{ gallons}$$

$$5.0 \text{ X } 10^8 \text{ gallons X } \frac{1 \text{ m}^3}{264 \text{ gallons}} \doteq 1.9 \text{ X } 10^6 \text{ m}^3 \text{ potable water}$$

Water usage for evaporator personnel is:

$$\frac{5 \text{ X } 10^6 \text{ hours}}{1{,}812 \text{ hours/person year}} \text{ X } \frac{20 \text{ gallons}}{\text{person day}} \text{ X } \frac{260 \text{ days}}{\text{year}} \text{ X } 1.1 = 1.6 \text{ X } 10^7 \text{ gallons}$$

$$1.6 \text{ X } 10^7 \text{ gallons X } \frac{1 \text{ m}^3}{264 \text{ gallons}} = 6.1 \text{ X } 10^4 \text{ m}^3 \text{ potable water}$$

Total potable water from tank farm and evaporator personnel is:

$$1.9 \text{ x } 10^6 \text{ m}^3 + 6.1 \text{ x } 10^4 \text{ m}^3 + 6 \text{ x } 10^4 \text{ m}^3 = 2.0 \text{ x}10^6 \text{ m}^3$$

9513385.0657

DISTRIBUTION SHEET

To	From	Page 1 of 1
'istribution	TWRS Environmental Compliance	Date July 21, 1995
Project Title/Work Order		EDT No. 611563, ~~609538~~
No Disposal Action Engineering Data Package for the TWRS Environmental Impact Statement, WHC-SD-WM-EV-099, Rev. 0		ECN No. n/a

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Central Files	A3-88	X			
C. P. Bader	S7-51				X
L. E. Borneman	R2-06	X (2)			
W. T. Dixon	H6-21				X
G. L. Dunford	S7-81	X			
B. G. Erlandson	H6-20				X
J. G. Field	G2-02				X
R. H. Engelmann	H6-26				X
E. A. Fredenburg	S2-48	X			
J. M. Garcia	R3-09				X
C. J. Geier	R2-36				X
C. C. Haass	S7-51	X (2)			
J. O. Honeyman	S7-81				X
'acobs Engineering Group, Inc. 3250 West Clearwater Kennewick, WA 99336		X (4)			
G. Jansen	H6-33				X
B. J. Knutsen	H6-33				X
J. L. Lee	R2-50				X
K. L. Morris	R2-76	X			
A. L. Ramble	H4-60				X
E. J. Slaathaug	H5-49				X
G. L. Smith	H4-60				X
A. M. Umek	S7-81				X
J. Weber	S1-57				X
R. D. Wojtasek	S7-84				X
LEB File/LB	R2-06				X

RECEIVED

AUG 8 1995